Engineering
Library

APR 18 1941

AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER

APRIL 15, 1941

SELECTING ROLLS FOR
TIMKEN BEARINGS

Why AND How WE DO IT . . .

It is impossible to grind all the tapered rollers for a TIMKEN Bearing to the same exact diameter. Within certain limits it doesn't matter what the diameter of the rolls for a bearing is if all the rolls for any one bearing are of the same diameter. To obtain identical size rolls we resort to selective gauging and the machines that do this job automatically are pictured above. The rolls, placed in a hopper, feed automatically one by one into a collet or master. The rolls will protrude at varying lengths from this collet depending on their diameter. The amount of this protrusion determines which electrical contact an actuated arm will make. Those contacts open magnetically controlled gates through which rolls pass to get to their proper containers. Naturally, the collet must be free from foreign matter, otherwise rolls could not be graded to their correct micro-inch diameter. That is why the roll gauging department pictured above is air filtered, why all rolls are first cleaned in a specially designed washer and why every conceivable precaution is taken to assure correctly sized rollers day in and day out.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

"WC_2" the Chemists Call it...

...We Call it "The BEST WAY" to get both

"WC_2" chemists call it in the laboratory . . . in the shop we call it tungsten carbide . . . and when high production and finish are essential in machining operations, we call it *The Best Way* to get such results.

But tungsten carbide alone is not sufficient, it must be backed up by a machine specifically designed for its use like a Heald Bore-Matic. A machine with extremely rigid construction throughout, velvet smooth hydraulic table control, force feed lubrication to table ways, ample flat and V ways for stabilized table travel, smooth, powerful V belt drive to boring head, super-precision bearings, with automatic pre-loading in boring heads.

Heald Bore-Matics have all the above features and many more. They will precision bore — face — turn — will groove, etc., in fact perform nearly all precision operations individually or in multiple.

May we send you installation photos of Bore-Matics working in your own industry. Your name and address is all we need.

ACCURACY *and* FINISH *Economically*

Above a Heald No. 48A is boring both ends of a bronze bushed airplane articulating rod. Accurate to .0001 for roundness and straightness and finish measures 7 micro inches R.M.S.

The HEALD Machine Co., Worcester, Mas

AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 84 Number 8

JULIAN CHASE, Directing Editor
P. M. HELDT, Engineering Editor JOS. GESCHELIN, Detroit Technical Editor
J. R. CUSTER, Ass't Editor JEROME H. FARRIS, Ass't Editor
E. L. WARNER, JR., Detroit News Editor HOWARD KOHLBRENNER, Art Editor
L. W. MOFFETT, Washington News Editor J. G. ELLIS, Washington News Editor
MARCUS AINSWORTH, Statistician

CONTENTS

Metals for Automobiles. *By James R. Custer* 415
Fighters in the Air War Over Europe 416
Air Scoops for Aircraft Carburetors 418
Aircraft Propeller Characteristics and Designs 420
Compounding Spark-Ignition Aircraft Engines 421
On Ground and Aloft with the Air Forces 422
Fighting Fires with Carbon-Dioxide Gas 424
New Features in the Packard Clipper 428
Combining Spring Efficiency and a Good Ride. *By Philip H. Pretz, M. E.* 430
Automotive Materials 434
Men and Machines 436
Production Lines 439
Business in Brief 440
News of the Industry 441
Calendar of Coming Events 443
Advertisers' Index 74

Copyright 1941 by Chilton Company (Inc.)

Automotive Division
Jos. S. HILDRETH, President and Manager
JULIAN CHASE, Vice Pres. G. C. BUZBY, Vice Pres.

OFFICES

Philadelphia—Chestnut & 56th Sts., Phone Sherwood 1424
New York—100 East 42nd St., Phone Murray Hill 5-8600. Chicago—Room 916 London Guarantee & Accident Bldg., Phone Franklin 4243. Detroit—1015 Stephenson Bldg., Phone Madison 2090. Cleveland—609 Guardian Bldg., Phone Cherry 4188. Washington—1061 National Press Bldg., Phone District 6877. San Francisco—444 Market St., Room 305, Phone Garfield 1721. Los Angeles—6000 Miramonte Blvd., Phone Lafayette 5525.
Cable Address.....Autoland, Philadelphia

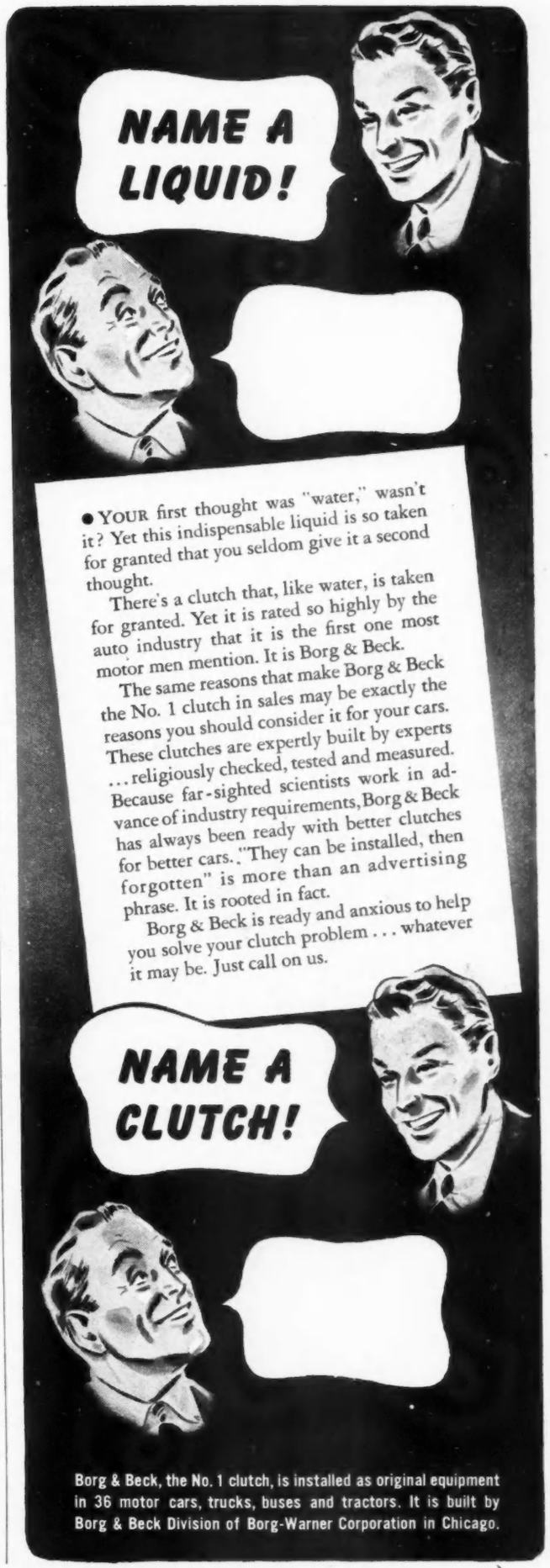
Member of the Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Automotive Industries—The Automobile is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903, the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by
CHILTON COMPANY
(Incorporated)

Executive Offices
Chestnut and 56th Streets, Philadelphia, Pa., U. S. A.

Officers and Directors
C. A. MUSSELMAN, *President*
Vice-Presidents
JOS. S. HILDRETH GEORGE H. GRIFFITHS
EVERIT B. TERHUNE J. H. VAN DEVENTER
C. S. BAUR
WILLIAM A. BARBER, *Treasurer* JOHN BLAIR MOFFETT, *Secretary*
JULIAN CHASE THOMAS L. KANE G. C. BUZBY
P. M. FAHRENDORF HARRY V. DUFFY CHARLES J. HEALE


NAME A LIQUID!
● YOUR first thought was "water," wasn't it? Yet this indispensable liquid is so taken for granted that you seldom give it a second thought.
There's a clutch that, like water, is taken for granted. Yet it is rated so highly by the auto industry that it is the first one most motor men mention. It is Borg & Beck.
The same reasons that make Borg & Beck the No. 1 clutch in sales may be exactly the reasons you should consider it for your cars. These clutches are expertly built by experts ... religiously checked, tested and measured. Because far-sighted scientists work in advance of industry requirements, Borg & Beck has always been ready with better clutches for better cars. "They can be installed, then forgotten" is more than an advertising phrase. It is rooted in fact.
Borg & Beck is ready and anxious to help you solve your clutch problem ... whatever it may be. Just call on us.
NAME A CLUTCH!
Borg & Beck, the No. 1 clutch, is installed as original equipment in 36 motor cars, trucks, buses and tractors. It is built by Borg & Beck Division of Borg-Warner Corporation in Chicago.

AUTOMOTIVE INDUSTRIES. Vol. 84, No. 8. Published semi-monthly by Chilton Co., Chestnut & 56th Sts., Phila. Entered as Second-Class Matter October 1, 1925, at the Post Office at Philadelphia, Pa.; Under the Act of Congress of March 3, 1879. In Case of Non-Delivery Return Postage Guaranteed. Subscription price: United States, Mexico, United States Possessions, and all Latin-American countries, $1.00 per year. Canadian and Foreign, $2.00 per year; single copies, 25 cents, except Statistical Issue (Mar. 1, 1941), 50 cents.

J&L STEEL

COLD DRAWN BARS

Precision, smooth finish, uniformity are the prime qualities you insist on in cold drawn steel bars. Our first responsibility to all our customers is to maintain these qualities.

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS • PITTSBURGH, PENNSYLVANIA

IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 84 April 15, 1941 Number 8

Black-Out Vehicle Lighting Demonstrated

The regional conference of the Illuminating Engineering Society (IES) was treated recently to a demonstration of "Black-out" lighting in the General Electric Nela Park Automotive Laboratory. Although the U. S. Army has not yet adopted measures for highway lighting under black-out conditions, Val J. Roper, head of the automotive lighting division at Nela Park, demonstrated three different experimental ideas for expediting the movement of military equipment on the highway.

The first of these is the use of a sealed-beam glass unit, interchangeable with the standard headlamp unit, but fitted with 100-watt filaments. The lens is suitably shielded and provided with a light filter which absorbs all but ultra-violet radiation. Only one headlamp is required and it is thought that the conventional power system of a modern vehicle will be capable of handling the single 100-watt unit without difficulty.

If a headlamp of this character is employed, Nela Park recommends the use of small roadway markers or screens placed on the ground to mark off the highway limits and obstructions. These screens are sprayed with fluorescent paint which is said to withstand weathering for considerable periods of time. In the laboratory demonstration, with all lights off, the headlamp described above activated the fluorescent screens sufficiently to make it quite safe to follow the outline of the road.

Many times more light intensity from the same fluorescent screens was afforded by another type of experimental mercury-vapor lamp attachment, also interchangeable with the standard sealed-beam lamp unit. This system has the disadvantage of greater cost and easier detection by enemy aircraft.

The third type involved the use of a special flashlight consisting of a fairly long cylindrical tube of large diameter with a 3 c.p. bulb at one end. The tube is fitted with an inexpensive condensing lens which produces a pencil of light of low intensity whose beam would make no contact with the walls of the cylinder. In addition the inside walls of the cylinder are painted black so as to absorb stray light. The pencil of light is projected downward so as to impinge upon plastic road markers which have the property of reflecting light back to its source.

This flashlight unit is extremely light in weight and is intended for mounting directly on the driver's cap or uniform helmet or by clamping directly at the driver's temple. This form of illumination is practically invisible to outside observers and would energize only the plastic markers which would outline the road right at the ground.

AVIATION INDUSTRIES **Page 416**

From all over the world come new ideas and designs in aircraft. In picture and text the pages of this section bring one right up to the minute. The design of air scoops for aircraft carburetors is one subject that is given some real attention and then there is a treatise on the characteristics of the different types of propellers. Aircraft engines come in for their share as well as the newest developments in war planes for both this country and the warring nations.

GENERAL

Metals for Automobiles **415**

Right now the supply and distribution of materials is the all-important question. What is being done by the different agencies that are in control of the situation and just how they are doing it is the subject matter of this article. It is timely and instructive.

Fighting Fires with Carbon Dioxide Gas **424**

One of the greatest hazards to mankind and particularly to industry is a fire. Their control, should they occur, and how to hold them to a minimum, is told in this article, particularly as applied to plants in the automotive industry.

NEW CARS

New Features in the Packard Clipper **428**

The refinements and changes introduced by Packard in their new Clipper models are described in text and pictures. Features of style as well as engineering developments are shown.

IS YOUR MATERIAL HANDLING SYSTEM *Improved* TO ITS HIGHEST EFFICIENCY TO MEET NATIONAL DEFENSE NEEDS?

Model "TNH" Tractor with pneumatic tires. Has powerful spur gear drive, exceptionally compact and easy to maneuver. Rated DBP capacity 485 lbs. normal—2000 lbs. ultimate.

Model "THTF-L"—Fork truck offers new opportunities for lowest cost unit load handling and storage on pallets. Capacities 3000 to 7000 lbs. Standard telescopic lift 119"—Collapsed height 83" for box car operation.

Model "CHTF"—Light-duty fork truck designed expressly for light unit load operation. Capacities 1000 and 2000 lbs. Has full telescopic fork lift 120"—Collapsed height 83". Exceptionally compact for box car operation and narrow platform or aisle maneuvering.

TRADE **AUTOMATIC** MARK

That's an important reminder at the start of 1941 because more than ever before every industry will be called upon to give unrelenting and timely support to the National Defense Program by meeting contract schedules.

This means you must have the highest efficiency in the movement and storage of materials to cope with your increased production demands.

That's where "AUTOMATIC" is prepared to perform its part in this program by furnishing you with proven equipment to give your system top-performance and low-cost materials storage and transportation. Industrial research over the past few years will give you the benefit now, without experimenting, of the latest and most satisfactory types.

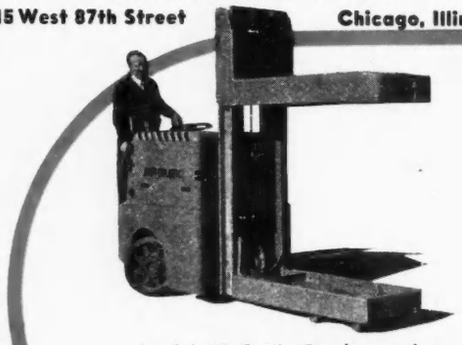
The most popular standard type "AUTOMATICS" are illustrated here. So write, 'phone, or wire for complete details or for an "AUTOMATIC" representative to discuss your material handling problems now.

☆ ☆ ☆

AUTOMATIC TRANSPORTATION CO.

DIV. OF THE YALE & TOWNE MFG. CO.

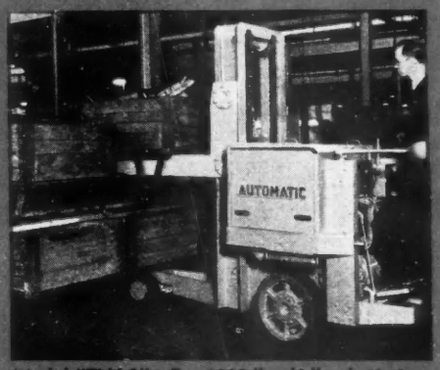
115 West 87th Street **Chicago, Illinois**



Model "TLO-5"—For heavy duty transportation plus tiering of 10,000-lb. capacity skid loads. Has standard platform 60" long, 26¼" wide, 11" high with 60" lift. The very latest in electrical control—construction styling and performance efficiency.

Model "LO-5"—For heavy-duty top-performance and efficiency to handle 10,000-lb. skid loads. Has standard platform 60" long, 26" wide, 11" high with 5" lift. Speed-O-Matic Drive control, Equa-poised drive and Dynetrol lift units.

Model "LN-3"—For speedy transportation and placing of 6000-lb. skid loads. Has standard platform 55" long, 27" wide, 10¾" high with 6" lift—Spur gear, drive and lift units—Rotor-Brush control system.



Model "TLN-3"—For 6000-lb. skidloads tiering plus transportation. Has standard platform 55" long, 27" wide, 10¾" high, 60" lift.

Model "EN-2"—Exceptionally speedy and efficient for ramp operation. Equipped with pneumatic tires for outdoor service. Platform deck 100" long, 51" wide, 29" high. Has heavy-duty spur gear drive—Hand wheel steer and Rotor-Brush control.

AUTOMATIC TRANSPORTATION COMPANY

DIV. OF THE YALE & TOWNE MFG. CO.

115 W. 87th St. CHICAGO, ILL.

Gentlemen: Please send details on models referred to above.

Name_____

Address_____

Company_____

City_____ State_____

WHEN YOU BUY TRUCKS · · *Buy* "AUTOMATIC"

AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 84, No. 8
April 15, 1941

Metals for Automobiles

Priorities and Conservation Possibilities of Substitution

By JAMES R. CUSTER

TODAY the supply and distribution of raw materials form the "Gordian Knot" which must be cut to provide adequately for defense needs and an orderly civilian economy. It is this problem that looms as the most difficult yet to face industrialists, military men and Government officials.

In an attempt at partial solution, at least, the Office of Production Management has instituted a priorities system with its nucleus in Washington. This system develops both a complex and delicate mechanism. Primarily it is intended to speed armament production by the scheduling of orders both as to their sequence and timing over the entire range of producer and manufacturer to meet the needs of the Army and Navy. Upon this system depends the synchronization of the manufacture of parts and their assembly into the final products. Its scope is vast—from nuts and bolts to battleships and thousands of warplanes, cannons, tanks and armored cars.

But the operation of the priorities system with regard to defense production is only part of its purpose. It also must function to the same degree in meeting civilian requirements with adequate supplies of raw materials. The proper coordination of the civilian needs with the defense needs is essential for the success of the latter. No longer is it just a matter of food and clothing for the civilian population. Great industries and millions of workers are dependent upon automobiles, electrical appliances, transportation facilities and many other products. With the growth of defense industries, their decentralization into industrially undeveloped localities, transportation of people and supplying their needs will become an ever-increasing problem.

To the Army and Navy Munitions Board has been delegated the responsibility of handling priorities in the military field, including Army and Navy contracts, those of certain foreign governments and of some U. S. Government agencies such as the Maritime Commission, Coast and Geodetic Survey, Coast Guard and the National Advisory Committee for Aeronautics. The priorities division of the OPM administers directly any necessary priorities in the civilian field, coordinates them with the military requirements, invokes industry-wide control when necessary and makes allocations of raw materials, and also handles the overall supervision of the priorities system in both the military and non-military fields.

How will the automobile industry fit into this new non-defense industrial structure? To what extent are the 1942 models likely to be affected by the supply of raw materials?

I went to Washington to obtain facts for answering those and other basic questions. Few concrete facts were available. Not that a stalemate exists. On the contrary, the industrial momentum is so fast, intensified more and more by the National Defense program, that the raw materials situation is changing from day to day, particularly with respect to metals for civilian needs.

The OPM priorities division has research studies underway on conservation, production and industry consumption of metals, is watching market developments closely, and already has placed aluminum, magnesium, nickel, and nickel-bearing steel, tungsten, five per cent of zinc production, machine tools and Neoprene supplies under its control to protect defense needs. Most alloy steels are said to be under consideration for similar control, which certainly would confront engineers and metallurgists with the problem of possible changes in the composition of gears, steering gear parts, axle shafts, ball and roller bearings, valves and other engine parts.

To direct the conservation, reclamation and substi-

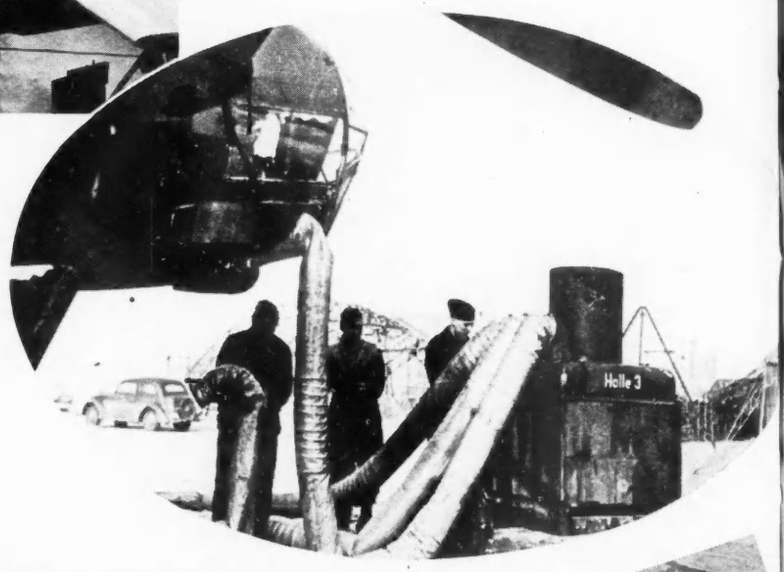
(*Turn to page* 452, *please*)

GENERAL

Fighters in the Air War

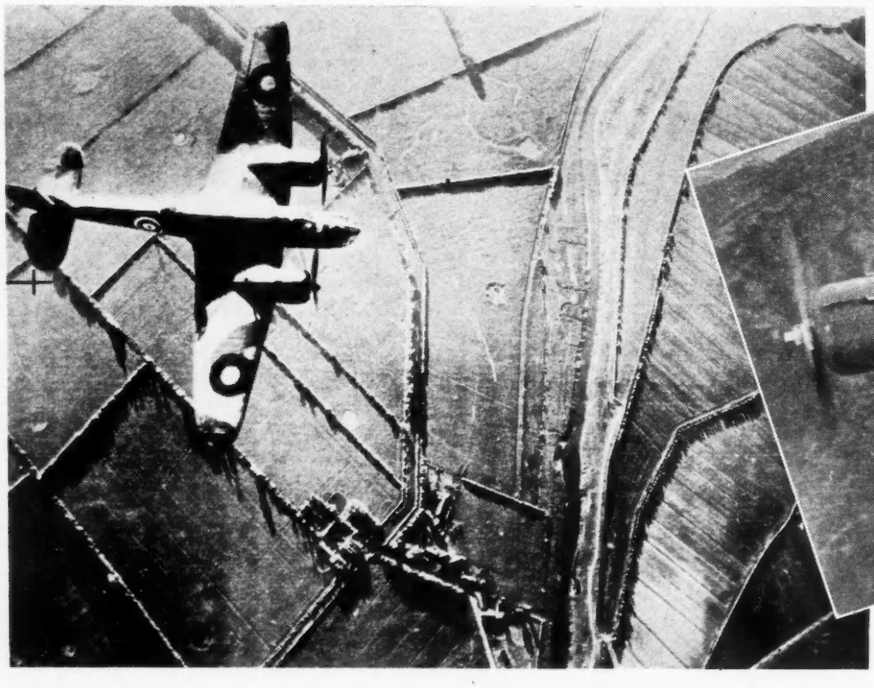
Patrol bombers for the Royal Norwegian Naval Air Force operating from Britain are being produced by Northrop at the new Hawthorne plant at the rate of one a day.
(Globe Photo)

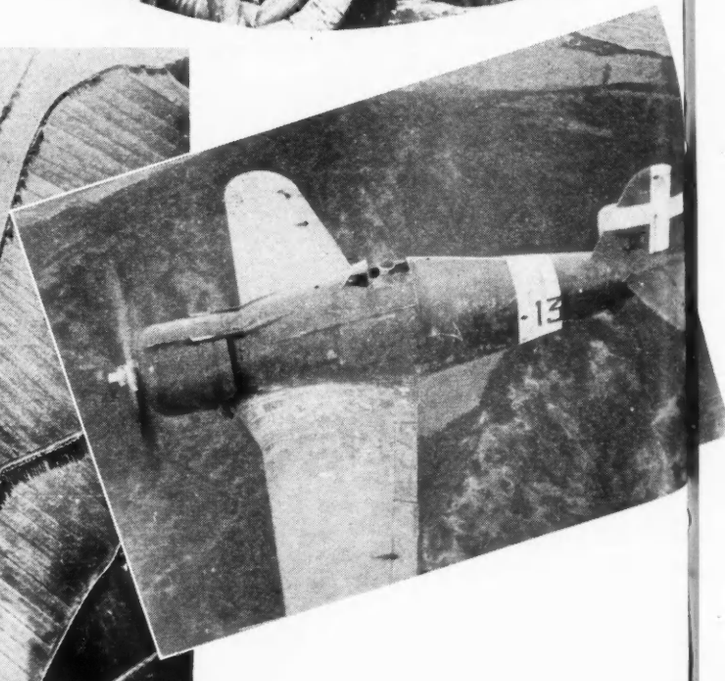
At right, a German ground crew is shown warming up the engine of a plane by means of a portable hot air unit used to save time and fuel in flight preparations during cold weather.
(International Photo)



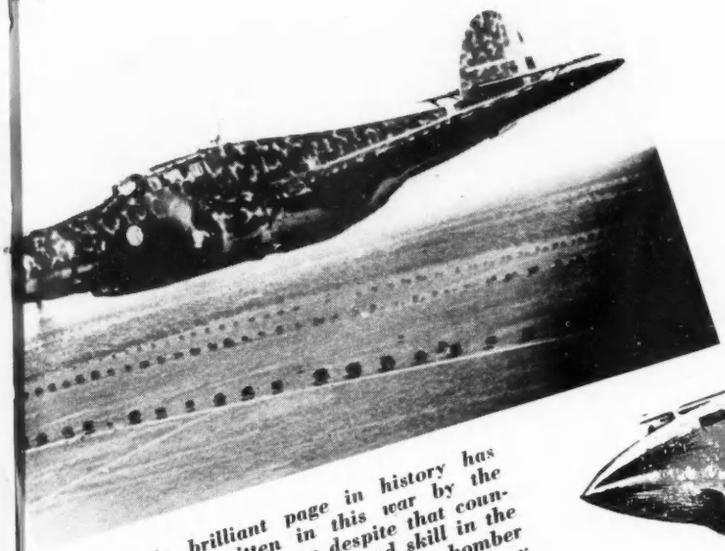
Below, at the left, in an official photograph of the R.A.F., is a British Blenheim bomber over France. Beneath the plane lies a section of the French channel coast which is kept under constant surveillance and bombardment to forestall attempts at invasion.
(Acme Photo)

At the right, below, an Italian plane flies over the battle ground in Albania.
(European Photo)

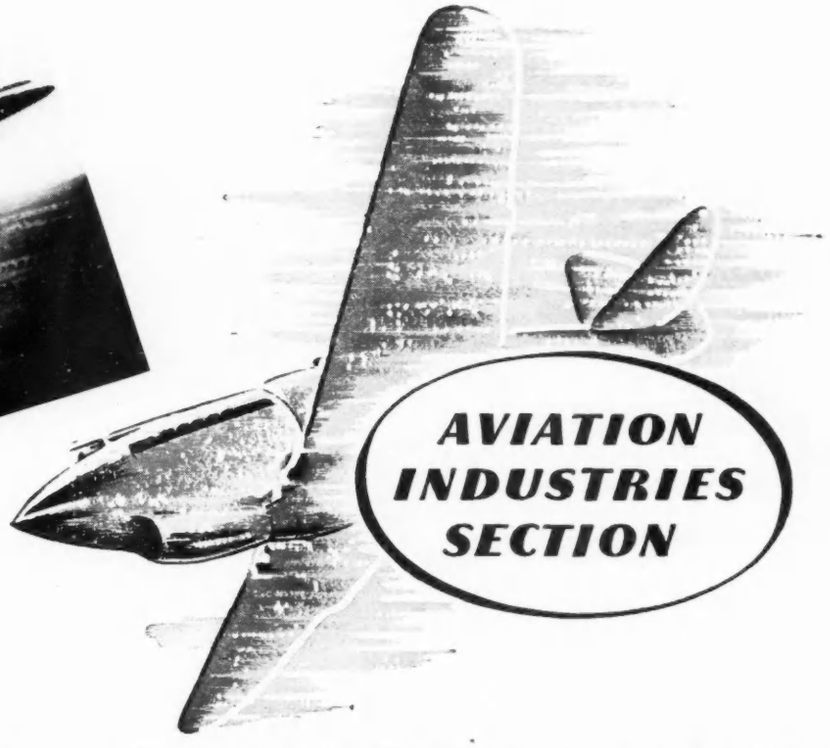




Over Europe



No brilliant page in history has been written in this war by the Italian air force despite that country's past demonstrated skill in the mechanical arts. Above, a bomber of, as their allies the Germans say it, "der Italienischen Luftwaffe." (European Photo)



AVIATION INDUSTRIES SECTION

The German's new Focke-Wulfe 187 destroyer plane, left and below, is equipped with two water-cooled, 12-cylinder V engines with hanging cylinders. It has guns mounted on the fusilage and engine nacelles, the latter firing between the propeller blades. One machine gun is said to be movable. It is an exceptionally fast plane of unique design. (European Photo)

(European Photos)

Air Scoops for Aircraft

IN ORDER that an automatic carburetor may compensate properly for variations in the temperature, pressure and velocity of the entering air, it must be capable of acting as an accurate, wide-range air meter. The metering function must be performed at the throat, where the fuel enters the air stream, and this calls for streamlined flow, or a very close approach to it, through the throat. Aircraft carburetors are usually provided with air scoops with an entrance outside the cowl. The entrance portion is directed horizontally forward, and as the scoop connects to a downdraft carburetor with vertical inlet, it will contain a right-angled turn or "Ell." In addition, a hot-air valve must be fitted to it.

Problems of carburetor air scoop design were discussed at the Aeronautic Meeting of the S.A.E. in a paper by M. J. Kittler, chief engineer of the Aircraft Division of Holley Carburetor Company. He pointed out that an air scoop ideal from the carburetor standpoint would comprise a long straight duct secured to the carburetor entrance flange and fitted with screens and a honeycomb to ensure uniform streamline air flow. The elbow should be provided with turning vanes, and the mouth of the scoop should have a well-rounded entrance. Such a design, extending far outside the cowl, is obviously impractical. In practice the mouth of the scoop must be just inside or just outside the cowl, and with this restriction in mind the following rules should be applied in the design of the scoop, according to Mr. Kittler.

The maximum length of straight section should be immediately ahead of the carburetor. The right-angled turn to which reference was made in the foregoing should be designed with fairly sharp corners, rather than with maximum external and internal radii. Turning vanes in the elbow are of advantage from the aerodynamic standpoint, but objectionable from the standpoint of icing hazards. In scoops that project above the cowl line, the turning vanes would be omitted because of the icing hazard, while in under-cowl scoops, where the passage leading up to the elbow usually has a number of bends in it that are vulnerable to impact icing, the turning vanes present no additional hazard.

The ducts of the air scoop preferably should be of rectangular section, with high aspect ratio, that is, relatively low in the vertical and broad in the horizontal direction. With ducts of this shape, the velocities along the inner and outer edges at turns do not differ as much as with ducts of low aspect ratio; besides, the aerodynamic load on the heater valve is reduced. This valve, which admits hot air to the scoop in proportions varying from zero to 100 per cent of the total flow, should be located as far from the carburetor entrance as possible, in order that the hot air may be thoroughly mixed with the cold air before reaching the throat. By placing the heater valve ahead of the elbow, the turbulence naturally created in the elbow helps to mix the hot and cold air. To permit operation in the "full-hot" position without undue loss in power, the mouth of the hot air passage in the scoop should be rounded, and the area of the heater valve and passages should be not less than 75 per cent that of the carburetor entrance area. Rapidly diverging sections should be avoided in the scoop, especially immediately ahead of the carburetor. Fig. 1 is a representative design of projecting-type scoop, while Fig. 2 is an example of an under-cowl scoop.

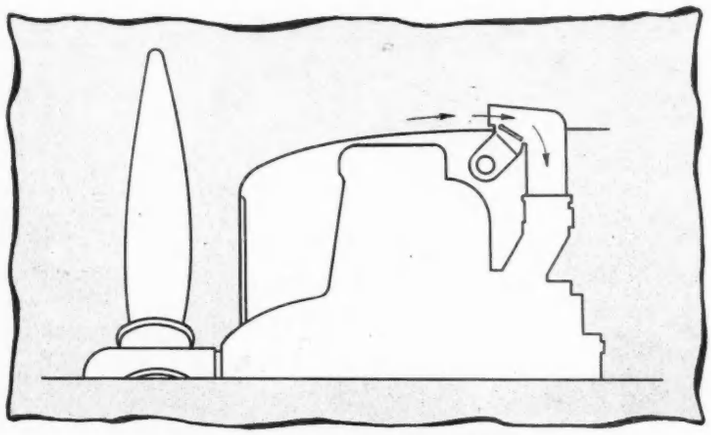


Fig. 1—Typical design of projecting scoop

One of the objects of a carburetor scoop is to provide a ramming effect. The effective ram, defined as the static head at the carburetor entrance, is equal to the theoretical ram minus the head corresponding to the velocity of the air in the scoop proper. The ram varies with the air speed of the plane, the density of the surrounding atmosphere, the horse power being developed, the location of the mouth of the scoop with

Carburetors

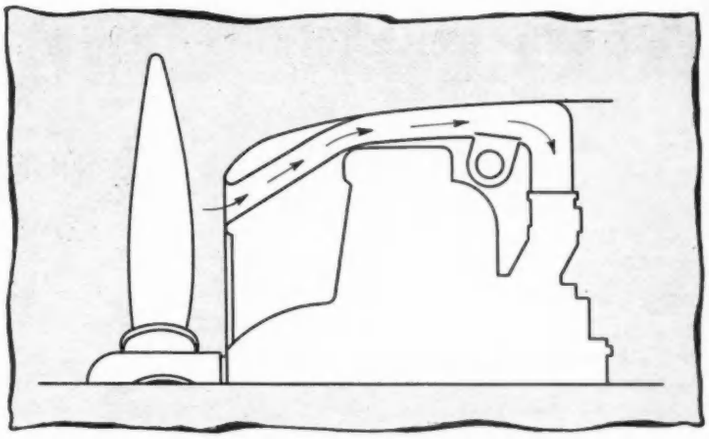


Fig. 2—Under-cowl scoop

respect to the surrounding pressures, and the position of the scoop heater valve. For constant engine power the effect of altitude on the ram is greater than that of air speed, so that although the air speed increases about one per cent with each 1000 ft. increase in altitude, the ramming effect decreases as the altitude increases.

Fig. 3 shows an airscoop designed for a Douglas DC-3 installation using a Wright G-102 engine with Holley Model 1375-H carburetor. Most of the parts

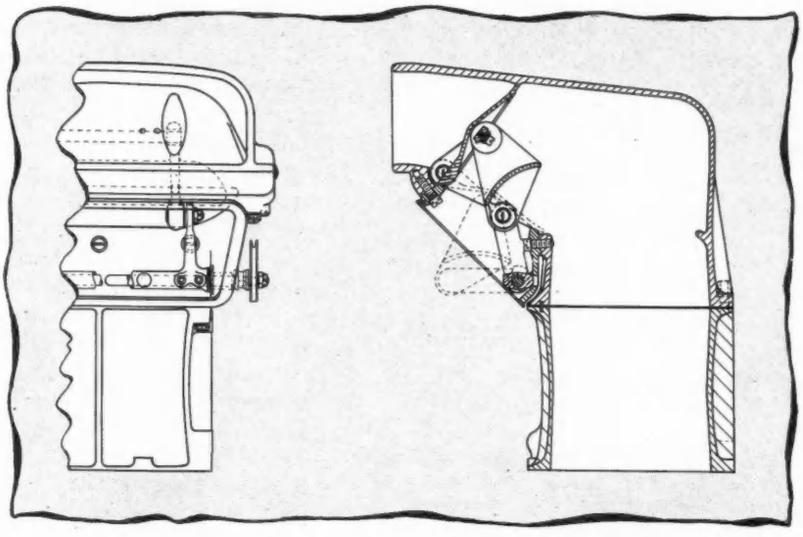


Fig. 3—Holley design of carburetor scoop for Douglas DC-3 with Wright engine

are magnesium castings. The riser shown can be easily varied in height to suit different installations. Scoop, elbow and riser are secured to the carburetor by means of "through" studs, which permits the riser to be made fairly light, as its material is subjected to compression only. The "through" studs screw onto the regular carburetor studs in the same way as nuts. There are no screws at the front of the scoop riser, which obviates the necessity of removing any parts of the heater-muff assembly when removing the scoop elbow.

All moving parts of the scoop are mounted in a single flange which dovetails into the scoop elbow proper. The heater valve is operated by a strut-and-lever mechanism, which provides for an over-center lock for the valve in the full-hot position. The strut has a built-in air-foil section which moves into position in the hot-air opening as the heater valve is opened, and acts as a vane which helps to guide the air around the sharp corner. All shafts are of steel of $\frac{3}{8}$-in. diameter and carried in oilless bushings. Play at the hinge points is prevented by steel thrust washers separated by wrinkle washers. The heat-valve-actuating shaft is provided with a control pulley for use with cable controls, and is made symmetrical, for use with either right-hand or left-hand control. The lever on the control shaft is provided with a valve which allows hot air to escape when the heater valve is shut off. As soon as the heater valve is opened slightly, the hot-air by-pass valve begins to close. The edge of the heater valve closely matches its seat in the scoop elbow, so that the cold-air passage can be completely shut off, which is quite important when flying through a heavy rain. The total weight of the unit, in cast magnesium, is $12\frac{1}{2}$ lb.

Shortly after the outbreak of the war, instructions were issued in England that every consideration in the matter of supplies should be given to manufacturers of electric vehicles. As a result of this encouragement the output rose from about 1000 vehicles per annum at the beginning of the war to between 2000 and 3000, and additional manufacturing facilities were being provided to increase the figure to 7000. For some reason, however, all the relevant orders were canceled later in the year, and at present their manufacture in Great Britain is at a standstill.

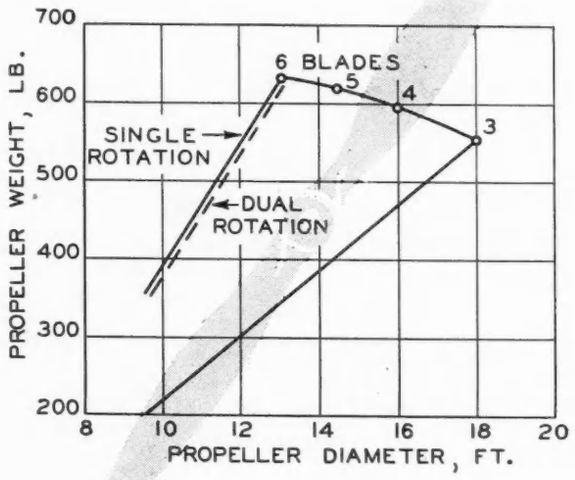
Aircraft Propeller

Characteristics and Design

AT THE Aeronautic Meeting of the S.A.E., one entire session of the meeting was given over to problems of propeller design and propeller characteristics. Three papers were presented at this session, as follows: Some Factors Influencing Aircraft-Engine-Propeller Vibrations, by C. M. Kearns of Hamilton Standard Propellers, Division of United Aircraft Corp.; Considerations in the Design of Modern Aircraft Propellers, by T. B. Rhines, Hamilton Standard Propellers, Division of United Aircraft Corp., and Vibration Characteristics of Three- and Four-Blade Propellers for High-Output Engines, by R. M. Guerke, Curtiss Propeller Division, Curtiss-Wright Corporation.

Mr. Kearns reported that tests on two-row 14-cylinder radial engines with specially-developed instruments disclosed a pronounced whirl vibration with a frequency of 2½ times crankshaft speed, and lesser vibrations with a frequency of 4½ times crankshaft speed. These frequencies could not be accounted for by ordinary engine-vibration theory. The usual method of analysis consists in developing a torque diagram from the indicator card and resolving this into its harmonics by harmonic analysis. G. L. Williams of the Pratt & Whitney Engine Division, in seeking an explanation for these puzzling frequencies, followed a somewhat different course and resolved the gas pressure on the individual pistons in a single-row radial engine into its harmonics, then added the forces on the crankshaft due to individual cylinders algebraically, and finally resolved the combined forces into vertical and horizontal components. He thus arrived at the conclusion that in a single-row radial engine of N cylinders there are periodic forces on the crankshaft of frequencies $(1 \pm \frac{k\,N}{2})$, where k is any integer. This, of course, explains the observed frequencies of 2.5 and 4.5 times crankshaft speed.

A number of propeller-tip failures occurred with a certain engine-propeller combination, sections of the blade tip of 3 to 4 in. length being lost under cruising conditions. When conditions were investigated on the test stand it was found that there was a resonant frequency close to 1800 r.p.m. Stresses near the point of failure were found to have nearly the same frequency as that of tooth mesh in the reduction gear. This frequency was close to 600 cycles per second. The stresses measured on the test stand were considered to be within the permissible strength limits for the blade under consideration. The reduction gear from the engine on which the most recent propeller failure had occurred was then installed on a test engine, and the test showed the peak stress to be much higher than that previously arrived at. When this particular gear was carefully examined by experts, no outward indications of its peculiar characteristics were found. It was remembered, however, that a similar previous propeller failure had occurred on the same engine. It was therefore concluded that in blade designs susceptible to high-frequency excitation, individual differences between outwardly identical reduction gears can account for the difference between a satisfactory and an unsatisfactory installation.



Weights of propellers with different numbers of blades and different diameters designed to absorb 2000 hp. at 400 m.p.h. at 25,000 ft. altitude.

Mr. Rhines discussed a number of problems currently confronting propeller designers, most of which arise from the recent enormous increase in the power that must be absorbed. He said that ten years ago most military planes had engines of about 500 hp. at sea level and were equipped with two-blade propellers of 9-ft. diameter. If allowance is made for a third blade, for reduction in rotational tip speed to compensate for increased airplane speed and altitude, and for a one-to-two increase in airplane speed itself, theoretical considerations indicate that a plane of

(*Turn to page* 455, *please*)

Compounding Spark-Ignition Aircraft Engines

IN AN endeavor to improve the fuel economy of aircraft engines the Power Plant Laboratory of the U. S. Air Corps, Materiel Division, has been experimenting on compound engines, and a report on this project was made at the S.A.E. Aeronautic Meeting by Ford L. Prescott, senior mechanical engineer (research) in a paper entitled "Compounding—Facts and Fallacies." Mr. Prescott previously had done research work relating to supercharging of aircraft engines and had obtained remarkably high mean effective pressures.

A two-cylinder compound engine was designed for the tests. In the high-pressure cylinder the conventional four-stroke cycle was used, air being taken in from a receiver which was supercharged by the low-pressure cylinder, and fuel added by the injection on the way to the high-pressure cylinder. The exhaust from the high-pressure cylinder was discharged through a port directly into the low-pressure cylinder. There were three valves in the low-pressure cylinder —an air-intake valve, an air-discharge valve, and an exhaust valve. Gases of combustion from the high-pressure cylinder were expanded in the low-pressure cylinder during one stroke and discharged during the next stroke, and during the remaining two strokes of the cycle the low-pressure cylinder served as an air pump, charging the receiver. The high-pressure crank leads the low-pressure crank by 120 deg. and the exhaust valve of the high-pressure cylinder opens 69 deg. before bottom center and, therefore, 9 deg. before the low-pressure crank reaches top center. During the following 127 deg. of crank motion the gases are expanded in the low-pressure cylinder. Then the low-pressure exhaust valve opens, and both exhaust valves are open during the next 27 deg. At this point the high-pressure exhaust valve closes, while the low-pressure exhaust valve remains open until 9 deg. after top center.

The two cylinders of the engine were cast in a single block, the high-pressure cylinder having a bore and stroke of 3⅝ by 5 in. and the low-pressure cylinder of 6⅜ by 6¼ in. This made the displacement of the high-pressure cylinder 51.7 and that of the low-pres-

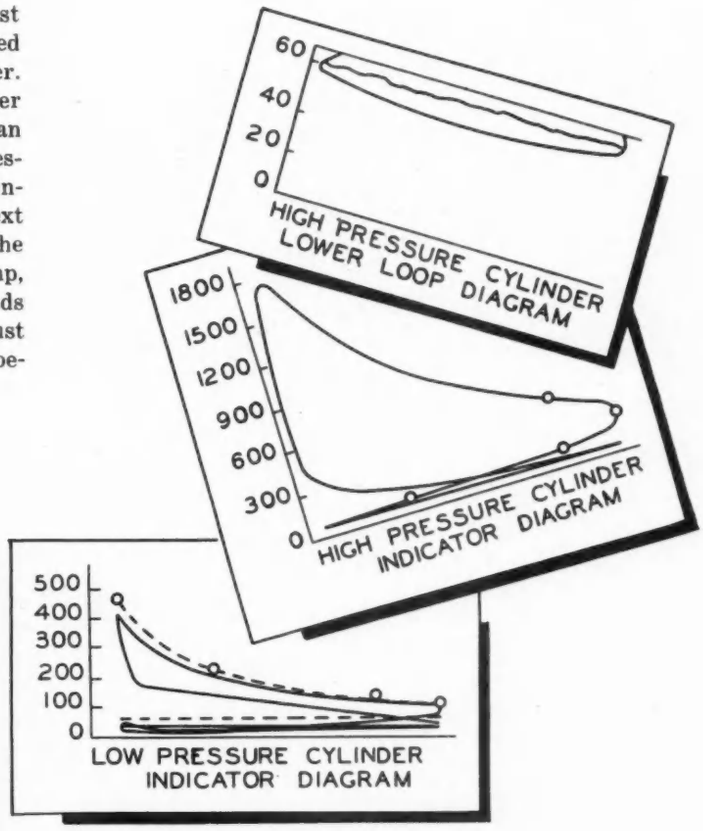


Fig. 1. (Above) Thru indicator cards for compound engine.

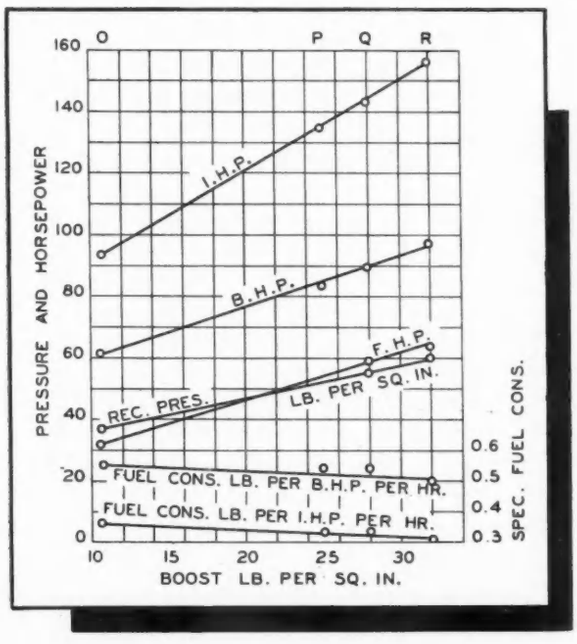


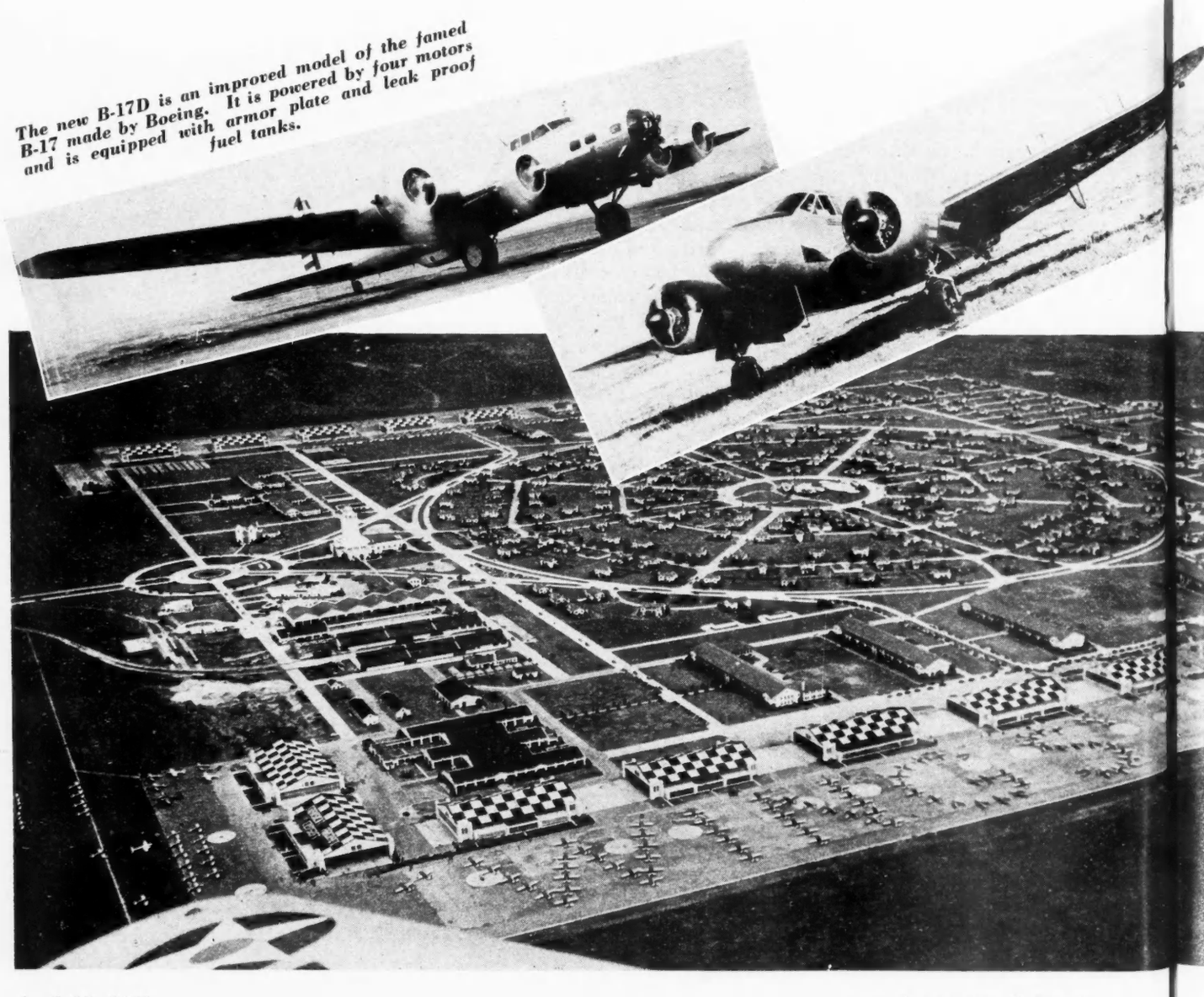
Fig. 2. (Left) Plot of data obtained in four runs at about 2000 r.p.m.

sure cylinder 199 cu. in., or 3.84 times as large. As the high-pressure cylinder had a compression ratio of 5, the total expansion ratio was about 19.2. It was found that when expansion was carried thus far, the additional friction loss was as great as the work gained by the additional expansion, so that nothing was gained. The stroke of the low-pressure piston, therefore, was reduced to 5 in., which made the displacement of the low-pressure cylinder substantially three times that of the high-pressure cylinder. A number of other changes were made, notably an increase in the lift and duration of opening of the air delivery valve of the low-pressure cylinder.

Fig. 1 shows indicator cards for the compound engine, that at the top being the lower-loop diagram of the high-pressure cylinder; that at the center, the regular indicator diagram for the high-pressure cylinder, and that at the bottom, the indicator diagram for the low-pressure cylinder. The diagram at the center shows an indicated m.e.p. of 705 lb. per sq. in., which is believed to be a record value. The fuel used would have permitted an even higher output, but the limit of the supercharging facilities was reached and the tests were terminated.

Fig. 2 is a plot of data obtained in four runs at about 2000 r.p.m. with the modified engine, after the compression ratio of the high-pressure cylinder had been reduced to 4. An outstanding feature is the high value of the friction horsepower. For instance, at 28 lb. per sq. in. boost the friction horsepower was 59

On Ground and Aloft with



The new B-17D is an improved model of the famed B-17 made by Boeing. It is powered by four motors and is equipped with armor plate and leak proof fuel tanks.

and the indicated horsepower 143, which made the mechanical efficiency of the compound engine roughly 59 per cent. The author pointed out that both the brake and the indicated specific fuel consumption decreased as the power output increased. The following conclusions were drawn from the results of the tests:

1. Fuels are available which make possible mean effective pressures in the high-pressure cylinder heretofore considered fantastic, resulting in release pressures to the low-pressure cylinder of 350 to 400 lb. per sq. in.

2. Two-stage expansion to a final ratio of 15:1 or more is feasible.

3. The pressure and energy drop through the high-pressure exhaust valve is not serious.

4. Modern internally cooled valves are satisfactory even under the unusual temperature and pressure conditions encountered by the high-pressure exhaust valve.

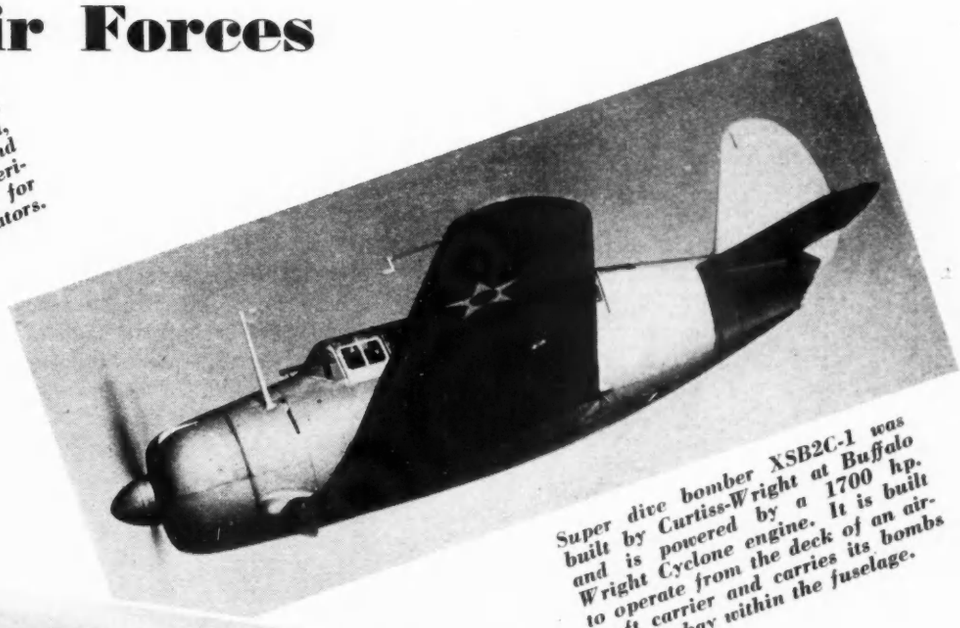
5. Compounding the expansion results in a definite increase in thermal efficiency.

6. Air compression by a high-speed compressor piston is not efficient, because of cylinder-wall friction and limited discharge-valve area. This results in low overall mechanical efficiency.

7. It is useless to expand the gases to a large volume, because the friction and pumping losses in the low-pressure cylinder more than compensate for the increase in thermal efficiency due to the increased expansion ratio

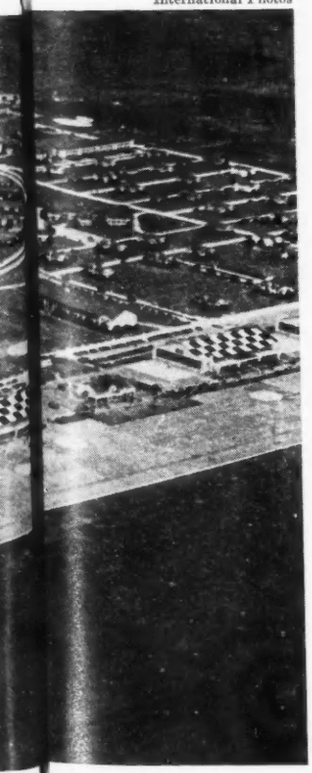
the U. S. Air Forces

The AT-7 is an all-metal, low-wing training monoplane made by the Beech Airplane Co. at Wichita, Kan. It carries a crew of five and is equipped with chart table, periodic compass, and drift sight for the use of the student navigators.



Super dive bomber XSB2C-1 was built by Curtiss-Wright at Buffalo and is powered by a 1700 hp. Wright Cyclone engine. It is built to operate from the deck of an aircraft carrier and carries its bombs in a bay within the fuselage.

International Photos



The B-25 was built for the Army by the North American Aviation Co.

Randolph Field, Texas, the West Point of the Air, has an enrollment of 900 cadets. This view was taken from an Army plane.

Fighting Fires with

KIDDE *High-Pressure System*

IN THE high-pressure system as developed by Walter Kidde & Co., Inc., carbon dioxide is stored in vessels which at normal atmospheric temperatures are under a pressure of the order of 850 lb. per sq. in. When the fluid is released it vaporizes and expands to 450 times its volume in the liquid state. The gas is released through special shielded nozzles and issues at low pressure, which prevents spreading the fire by causing violent agitation of the atmosphere and creates a continuous fire-extinguishing blanket, according to the sponsors.

The system operates on either the "total flooding" or the "local application"

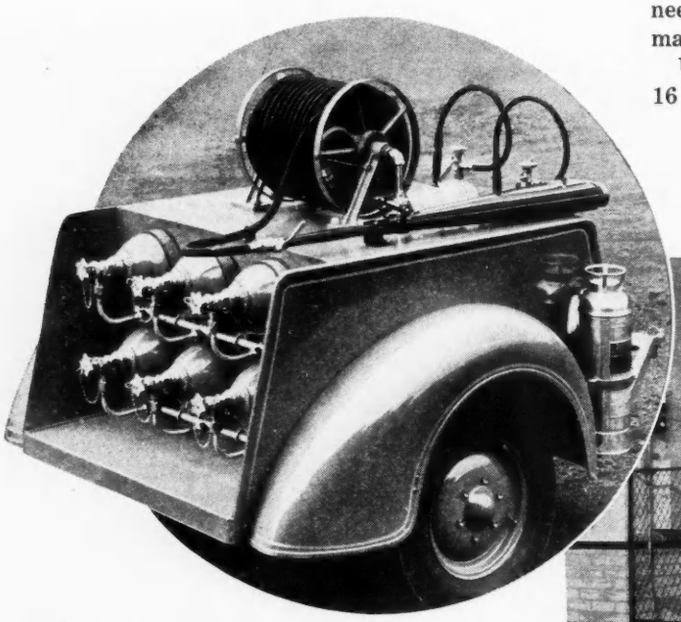
(*Turn to page* 427, *please*)

CARBON dioxide has been found to be an excellent fire-extinguishing medium especially for industrial plants in which such flammable liquids as lacquers, quenching oil, and gasoline are being handled. It acts by smothering the flame, reducing the oxygen content of the surrounding atmosphere to a degree where it no longer can support combustion. Carbon dioxide is an inert gas for which many industrial uses have been found, particularly in refrigeration and fire fighting. At normal atmospheric temperature carbon dioxide is a gas; in fact, it is a minor constituent of the atmosphere, being liberated by combustion, fermentation, and by the exhalation of animals. It can be liquefied by compression, and it also can be reduced to the solid state, being then known as dry ice.

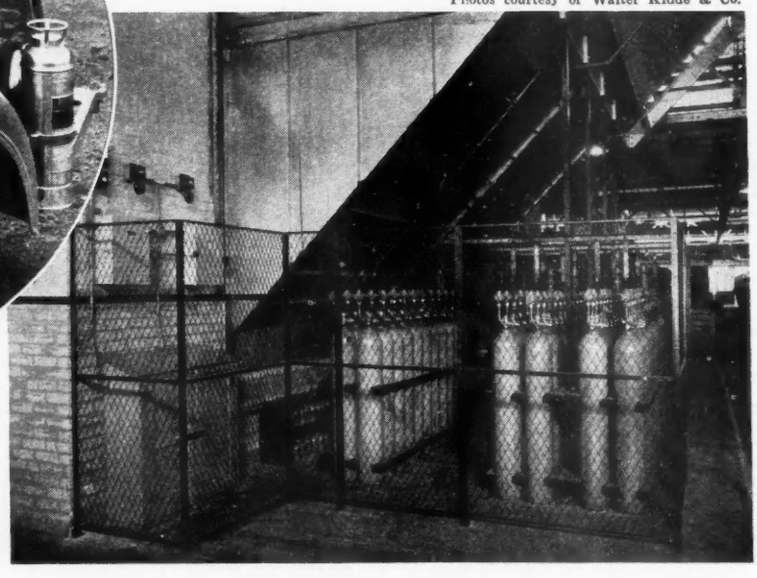
An advantage claimed for carbon dioxide as a fire-extinguishing medium is that it is "clean and dry" and will not contaminate the contents of dip tanks, nor spoil finished products which have not been injured by the fire itself. The fact that it turns into a gas when released enables it to penetrate to all parts of a room and smother a fire at any point therein. It will snuff out a fire in burning liquid flowing from a broken pipe connection, and it will extinguish a blazing, newly-painted fender or other part suspended several feet above a drain board. To extinguish flame by the smothering process, the atmosphere must be diluted with carbon dioxide gas until the oxygen content has been reduced from the normal 21 per cent to 14 or 15 per cent.

As a guide in estimating the volume of carbon dioxide needed to protect any given space, the following table may be used:

Up to 1600 cu. ft. of space—one pound of gas for every 16 cu. ft.



Photos courtesy of Walter Kidde & Co.



In the circle is a Kidde trailer unit carrying 300 lb. of carbon dioxide in reel-and-nozzle-equipped fire fighter. It is for industrial fire brigades, utility company garages or airport protection. At the right are the cylinders which protect the diptank, drainboard and ovens in a large automobile plant. There is over a ton and a half of carbon dioxide in this Kidde installation.

Carbon-Dioxide Gas

Up to 4500 cu. ft. of space—one pound of gas for every 18 cu. ft.

Up to 50,000 cu. ft. of space—one pound of gas for every 20 cu. ft.

Over 50,000 cu. ft. of space—one pound of gas for every 22 cu. ft.

Two different systems of fire protection by means of carbon dioxide have been developed. They may be designated as the high-pressure and the low-pressure system. In the high-pressure system the carbon dioxide is stored in I.C.C. high-pressure vessels or containers which are filled to 68 per cent their total capacity (liquid weight). The pressure within the vessel varies with the temperature; if the liquid carbon dioxide occupies 68 per cent the total volume of the vessel, the internal pressure is 840 lb. per sq. in. at 70 deg. Fahr. and rises to 2260 lb. per sq. in. at 130 deg. At zero Fahr. the pressure is 290 lb. per sq. in.

In the low-pressure system the carbon dioxide is stored in vessels or containers which are lighter in weight, relatively, than the high-pressure vessels, and which can be filled more nearly completely (95 per cent). A refrigerating system is provided. Its purpose is to limit the pressure by maintaining the temperature of the vessels within predetermined limits.

In the accompanying articles the two carbon-dioxide fire protection systems, are described, together with some special applications in the automotive and aircraft industries. For information regarding the two systems and for general data on CO_2 and its use in fire fighting we are indebted to Herbert W. Lange, chief engineer, Fire Division, Cardox Corp., and to P. W. Eberhardt, manager, Industrial Division, Walter Kidde & Co.

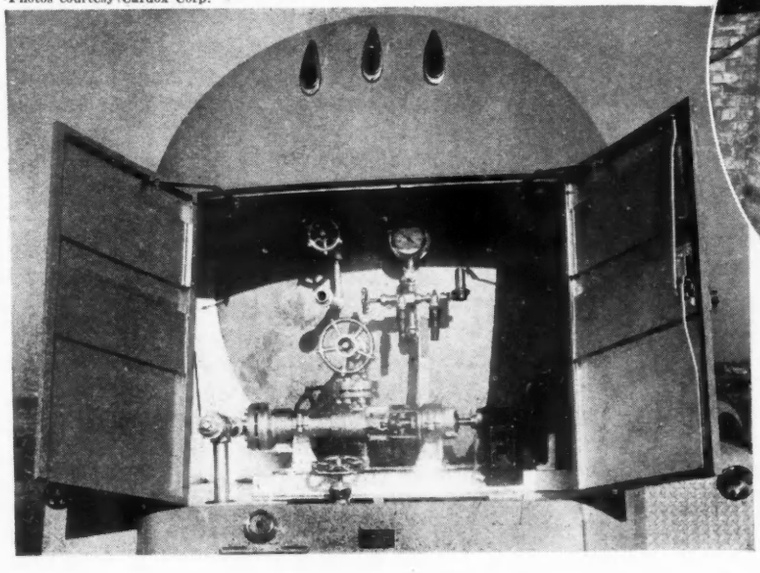
CARDOX *Low-Pressure System*

THE LOW-PRESSURE method of fire-protection by carbon dioxide as developed by the Cardox Corporation of Chicago, permits of the economical transport, storage and transfer of refrigerated liquid. Large pressure vessels can be used for the storage of the liquid in bulk, and vessels for this purpose, designed in accordance with A.S.M.E. standards, have been manufactured in capacities from ¼ to 125 tons. Such vessels with an aggregate capacity of more than 900 tons are said to be in service at present, including 200 tons on wheels.

The storage tanks are equipped with a refrigerator coil and mechanical refrig-

(*Turn to next page, please*)

Photos courtesy Cardox Corp.

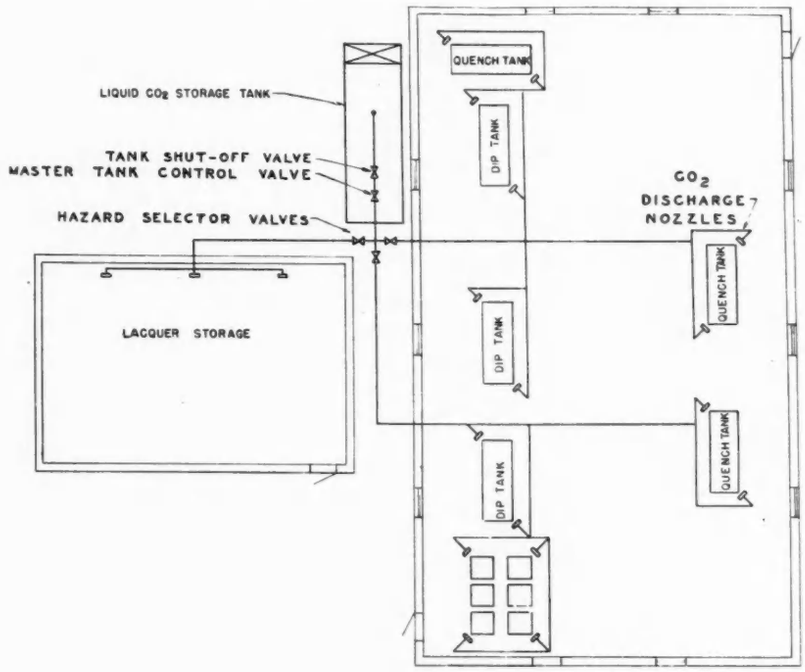


At the left is shown the transfer pump and other controls for delivering liquid carbon dioxide to Cardox installations. In the circle above is seen a Cardox discharge in a lacquer storage room. Nozzles have a discharge rate designed to discharge carbon dioxide of from 100 to 900 lb. per minute each.

GENERAL

CARDOX LOW-PRESSURE SYSTEM

(*Continued from preceding page*)



Cardox layout for protecting miscellaneous hazards.

erator. Each vessel is thermally insulated to retard heat absorption. The insulation and the pressure vessel are hermetically sealed in a sheet-metal housing. As heat slowly penetrates the insulation, the pressure in the vessel rises, and when it reaches a predetermined point, a pressure-controlled switch starts the refrigerating unit. When the temperature and pressure have been sufficiently lowered, the automatic switch stops the refrigerator. Supplementary control devices not dependent upon electric power are provided to protect the tank and its contents.

Each vessel is equipped with a pressure gage and a liquid-level gage. Special electrical alarm contacts can be provided with both units to give automatic warning of abnormal changes in pressure or liquid level.

The ¼ ton units may be designed as fixed or portable fire protection units. They are also adaptable as hose reel units for manual application. Larger stationary systems also may be equipped with manually-operated hose reels.

Several bulk low-pressure fire-protection systems are installed in the automotive industries. One protects 32 separate hazards; another protects 54 hazards, each individually, without affecting the protection of any remaining hazard while one is being served. At the time of writing, a system is on the drafting boards which when installed will protect 80 separate hazards automatically.

A fire protection system employing bulk low-pressure carbon dioxide is installed which provides automatic protection for any two of a variety of protected hazards, and in addition incorporates a reserve supply for manual operation which will flood the entire premises in case of a general fire. Any combinations of protection can be designed to meet specific requirements. A practice which was developed to obviate even short interruptions in production is to provide a double supply of carbon dioxide to give protection if a second fire should break out immediately after one has been extinguished.

In the case of room flooding, it is the practice to introduce sufficient carbon dioxide to reduce the oxygen content to such a point that a fire cannot be sustained.

The same principle can be applied in the case of outdoor fires, and then calls for the rapid application of large quantities of CO_2 to build up high-enough concentrations in an imaginary cubicle of definite location. Intense fires involving large transformers are said to have been extinguished in this manner even in a wind of 30 m.p.h. Systems protecting outdoor hazards of this type are installed.

The quenching nozzles used with this system are simple, and protection can be provided for shops as well as for storage rooms regardless of the size of space involved. Examples in the automotive industry where such protection is specially required include heat treating departments where quenching oils are used, and storage rooms where stocks of lacquer or oils are kept. The equipment required and the method of installation are identical since the active principle consists of the reduction of the oxygen content of the air to a point where combustion ceases. The accompanying diagram shows a Cardox lay-out to meet the conditions just described.

Local application to indoor hazards is similarly practicable. A single-story building of 100,000 sq. ft. floor area and 20 ft. high, housing a variety of severe and somewhat separated hazards, such as test tables, spray booths, quenching baths, machine oils, and the like, can be protected by treating each hazard area separately by means of local application. In the event of a general fire, or one that got out of bounds because of

some unexpected occurrence, such as an explosion or bombing, it would be possible to flood manually the entire premises to provide an inert condition. According to N.B.F.U. Standards for inerting, the total flooding of such a structure would require 50 tons of carbon dioxide.

As an example of the type of installation required with the bulk low-pressure dioxide system, let us assume a large hangar housing a number of super bombers. Such a hangar may be 300 by 300 ft. in floor area and 60 ft. high. One 125-ton tank would provide sufficient CO_2 to create an inert condition within the structure. It is claimed that, should fire break out and gain sufficient headway to warrant discharging the system, it would be extinguished promptly and without damage beyond that caused by the fire itself.

KIDDE HIGH-PRESSURE SYSTEM

(*Continued from page* 424)

principle. Total flooding means that enough gas is released to flood the entire room or space, such as an oven, and to provide an atmosphere from floor to ceiling which will not support combustion. Local application calls for the concentration of carbon dioxide gas at a specific point and involves the applying, at that point, of only a sufficient quantity of the extinguishing agent to smother fire in that local area.

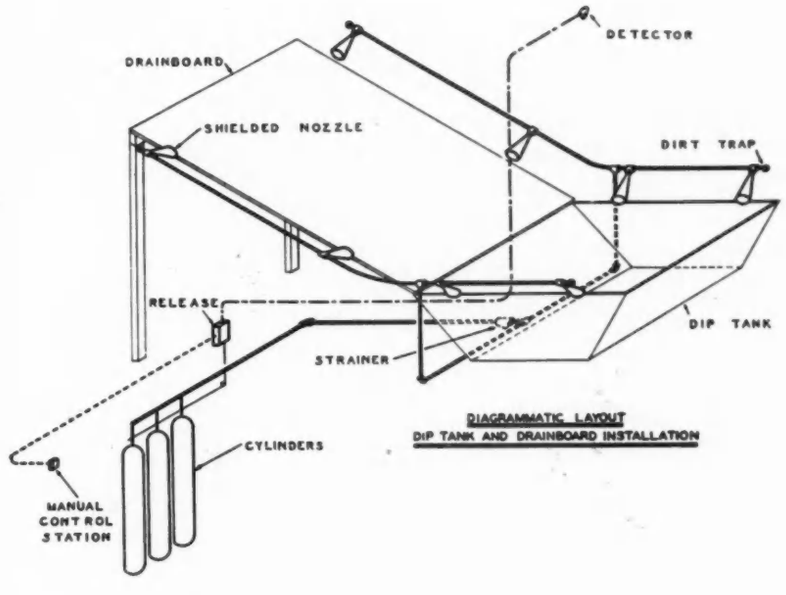
With both methods high-pressure cylinders are usually located away from the protected area. For total flooding, the gas is piped to shielded nozzles which are placed at shoulder height around the room or enclosure, while in local application these nozzles are directed onto the protected area, so placed as not to interfere with operation. Frequently local application and total flooding are combined for simultaneous discharge, particularly in the continuous dip and bake processes.

An accompanying diagram shows a typical arrangement of the nozzles for local application in a dip tank and drain board installation. Notice that the discharge is directed at the surface of the liquids and across the face of the drainboard. This insures that the fire-killing gas quickly blankets the burning contents of the tank and the drainboard, and the fire is smothered from the bottom up. When the discharge is aimed at liquid level in the tank and the drainboard face, all flames there are extinguished, and the expansion of the gas carries it up to the finished parts, despite obstructions formed by conveyor hooks and the parts themselves.

In the ovens, the total flooding method is followed. Sufficient gas is released to fill the entire space with carbon dioxide. Openings essential for operation are screened by special nozzles.

These systems may be either automatic or manually-controlled, and often are a combination of both methods. In most cases the dip-tank, drainboard and oven are equipped with fire detectors which operate on the rate-of-temperature-rise principle. When fires occur, the sudden abnormal heat-rise is picked up by the actuator and the shock is transmitted to the automatic release of the extinguishing system. This mechanism is said to be so sensitive that the heat of a match can trip it and pour the charge of fire-killing carbon dioxide onto the tank and drainboard, and into the oven.

This extinguishing system can be made to do incidental jobs as well. For instance, gas-operated pressure trips will close doors, windows, and exhaust dampers to confine the fire to the protected space. Pressure-operated switches shut down the conveyor and the motors, and close down the heating unit. By the same trip method, a dump valve on the dip-tank is opened. Provision is often made for screening exits and entrances of ovens with a curtain of carbon dioxide.



Arrangement of Kidde built-in carbon-dioxide extinguishing system for diptank and drainboard protection. Nozzles, placed directly above surface of tank and at sides of drainboard, blanket entire area with a cloud of fire-smothering gas. Rate-of-temperature-rise detector (above tank) and manual controls (left) release the gas.

New Features

IN THE new addition to current Packard production—the Clipper—the front end retains some of the characteristic Packard lines, but its appearance is enhanced by a long, narrow, die-cast radiator grille at the center, flanked by long horizontal die-cast grille bars set low in the front-end sheet metal. The Clipper has the same wheelbase (127 in.) as the "120"; its shipping weight is 3725 lb. (as compared with 3535 lb. for the 120); its road weight, 3870 lb. The advanced and quite original exterior treatment can best be judged by an inspection of the photographs. An outstanding feature of the new model is its low center of gravity, which was made possible by a new chassis frame and new front and rear suspensions. Among the mechanical features there are a number that are new in Packard practice.

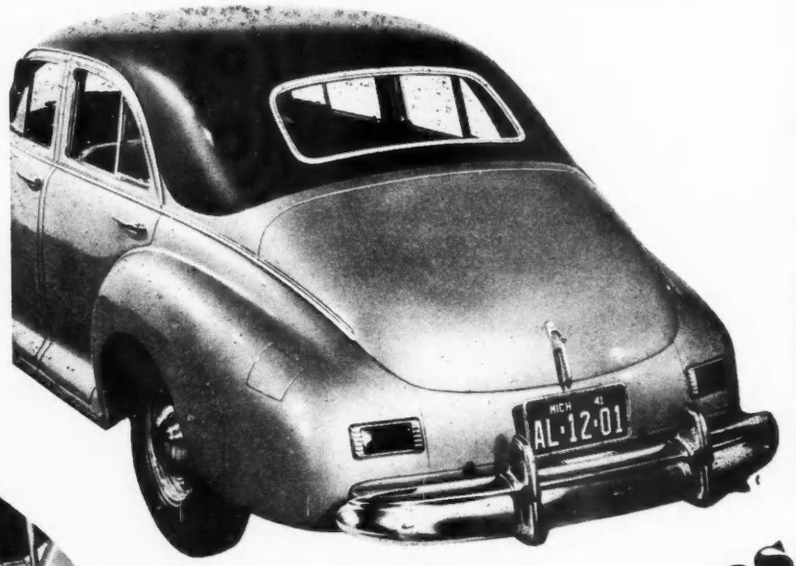
Rear-seat comfort in the new car is said to be comparable with that of the front seat, this result having been achieved by a redistribution of weight, unique features in the rear suspension, and the provision of a direct-acting fifth shock absorber incorporated in the rear stabilizer.

Body width exceeds by nearly a foot the height of the roof from the ground. The clear width of the front seat is 56⅞ in.; that of the rear seat, 50½ in. This model is offered as a six-passenger four-door sedan only. Despite the very low roof there is plenty of interior headroom—36⅞ in. in front and 37 in. in the rear.

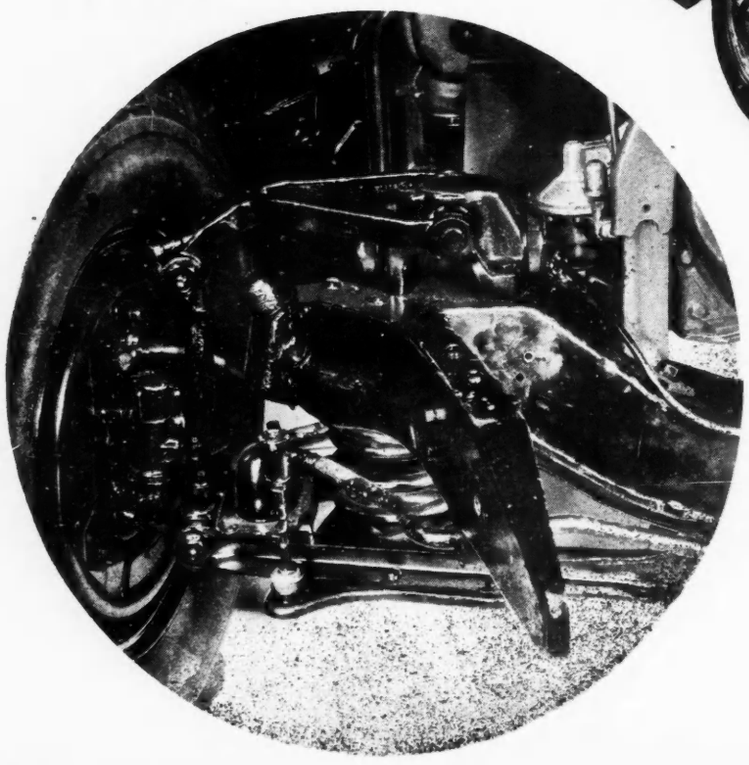
Among the novel body features are one-piece front fenders which include the entire hood sides, a one-piece bonnet top which hinges selectively at either side and is latched from inside the car by control levers on opposite sides of the instrument panel, and a one-piece stamping at the rear which includes both the fender and the short rear-quarter panel. Gravel shields are provided at both front and rear. Both front and rear fenders are faired into the contours of the front-door outer panels. Concealed running boards are provided.

Except for a higher compression ratio and a higher power rating, the engine has the same mechanical specifications as the One-Twenty. It is not interchangeable with the latter, however, as it is provided with a special oil pan to allow for the forward mounting, and has special pads and attachments. It is an eight-cylinder, in-line, L-head engine of 3¼ in. bore by 4¼ in. stroke (282 cu. in. displacement), rated 125 hp. max. at 3600 r.p.m., with cast-iron head and a compression ratio of 6.85. Of its three rubber supports the front one is the same as that on the 120, while the two rear mounts

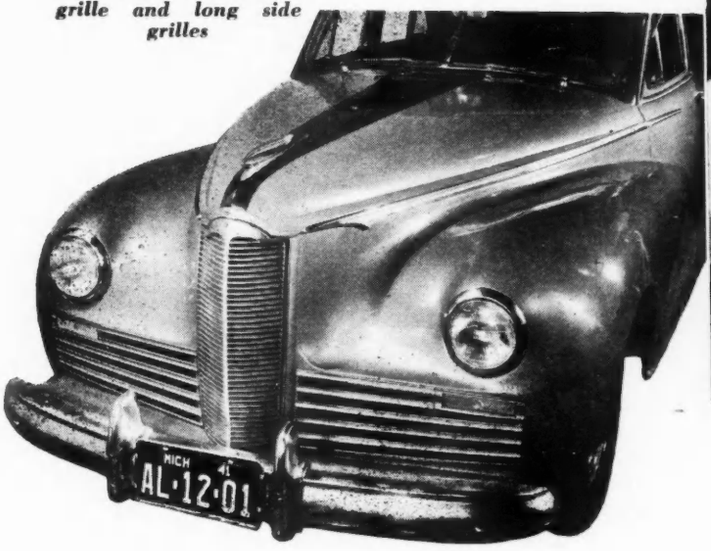
Rear end of Packard Clipper, showing concealed tank filler, recessed tail lamps and substantial rear bumper



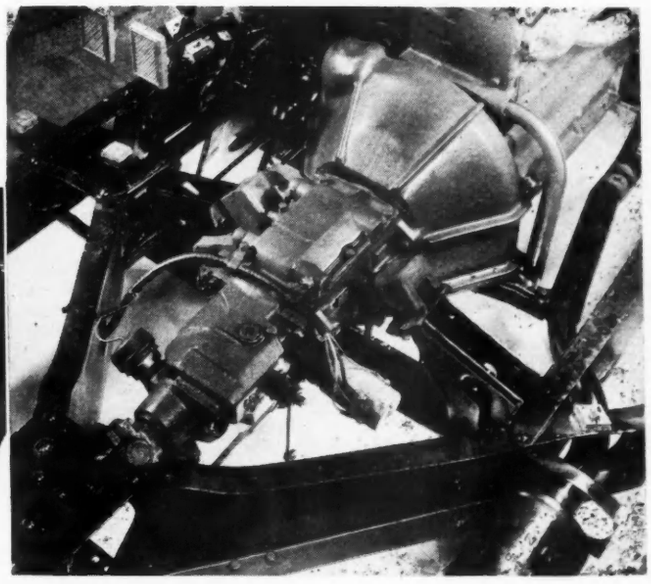
New wishbone type front end suspension system.



Front end of the Packard Clipper, showing deep narrow center grille and long side grilles



Electromatic drive arrangement. Note removable cross member and new engine mounts under transmission. At the right may be seen a portion of the crankcase ventilator outlet pipe



in the PACKARD CLIPPER

are modified to suit a removable frame cross member that facilitates overhaul operations.

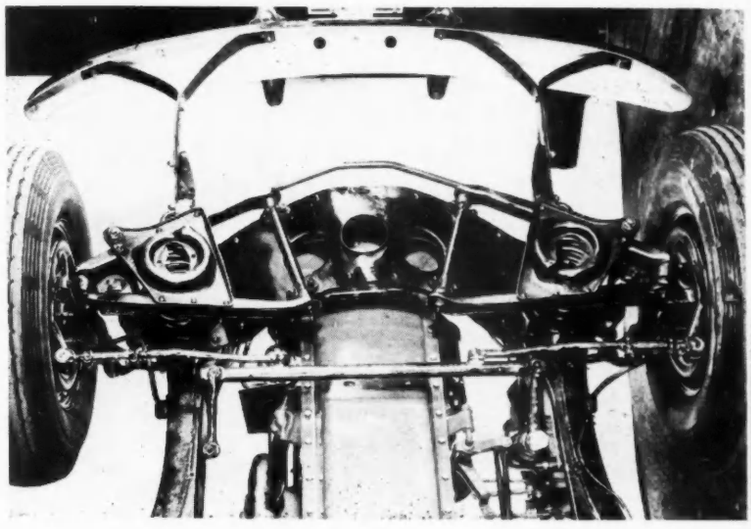
Crankcase ventilation has been improved, the system now incorporating a longer oil filler pipe raising the air inlet above the top of the engine, with its mouth facing the radiator. An electrically-operated oil gage is fitted. Starter control is by the accelerator pedal. A 17-plate Willard battery of 120 amp.-hrs. capacity is standard equipment. It has its cells arranged end-to-end and is mounted under the hood, with adequate provision for cooling.

The transmission is unchanged, except for the adoption of new synchronizers which reduce shifting effort. In addition, it is fitted with an extension at the rear for the dual purpose of reducing the length of the propeller shaft and to permit the use of the new slip joint. Overdrive is offered as optional equipment. When the overdrive is specified, the extension is left off.

Electromatic drive also is offered as optional equipment. Incidentally, the control has been changed in detail by the adoption of a diaphragm-type power unit which is said to improve clutch action materially.

Gear shifting effort has been reduced by the introduction of a unique linkage embodying a neutral link between the levers on the steering column and the linkage to the transmission. This eliminates errors in geometry due to the variable movement of the power-

(*Turn to page* 460, *please*)



Worm's eye view of front end, showing detail of front cross member, lower support arm, and parallel-arm steering linkage. At the right may be seen the bell-crank levers for the gear-shift mechanism. Note mounting on engine and method of pivoting the vertical shaft

Combining S

By

PHILIP H. PRETZ, M.E.*

DURING the past decade, greater strides than ever before have been made in reducing driver and passenger fatigue. Consequently, motorists generally think of spring development as an effort to increase comfort. It may be granted without argument that automobile engineers have accomplished much along this line during the period cited. There is, however, another phase to spring development, which is of equal importance to the automobile manufacturer, and which may be referred to as the increase in spring efficiency.

Because of the very divergent applications of springs, it may seem difficult to arrive at a suitable basis of comparison. In a clock, for instance, the balance spring releases its energy five times per second, while the main spring may take eight days to release its energy. However, one thing common to all springs is the energy-storing ability due to internal work in the material. If a given amount of work is done with less material by one spring than by another, then the first is more efficient. In this paper, therefore, the term "spring efficiency" as applied to any given type of spring will be defined as the energy stored, or the work done, per unit volume or weight of spring material.

Spring efficiency as here defined has nothing to do with the riding qualities of the car. A car may have a high spring efficiency and still have poor riding qualities. It will be readily ad-

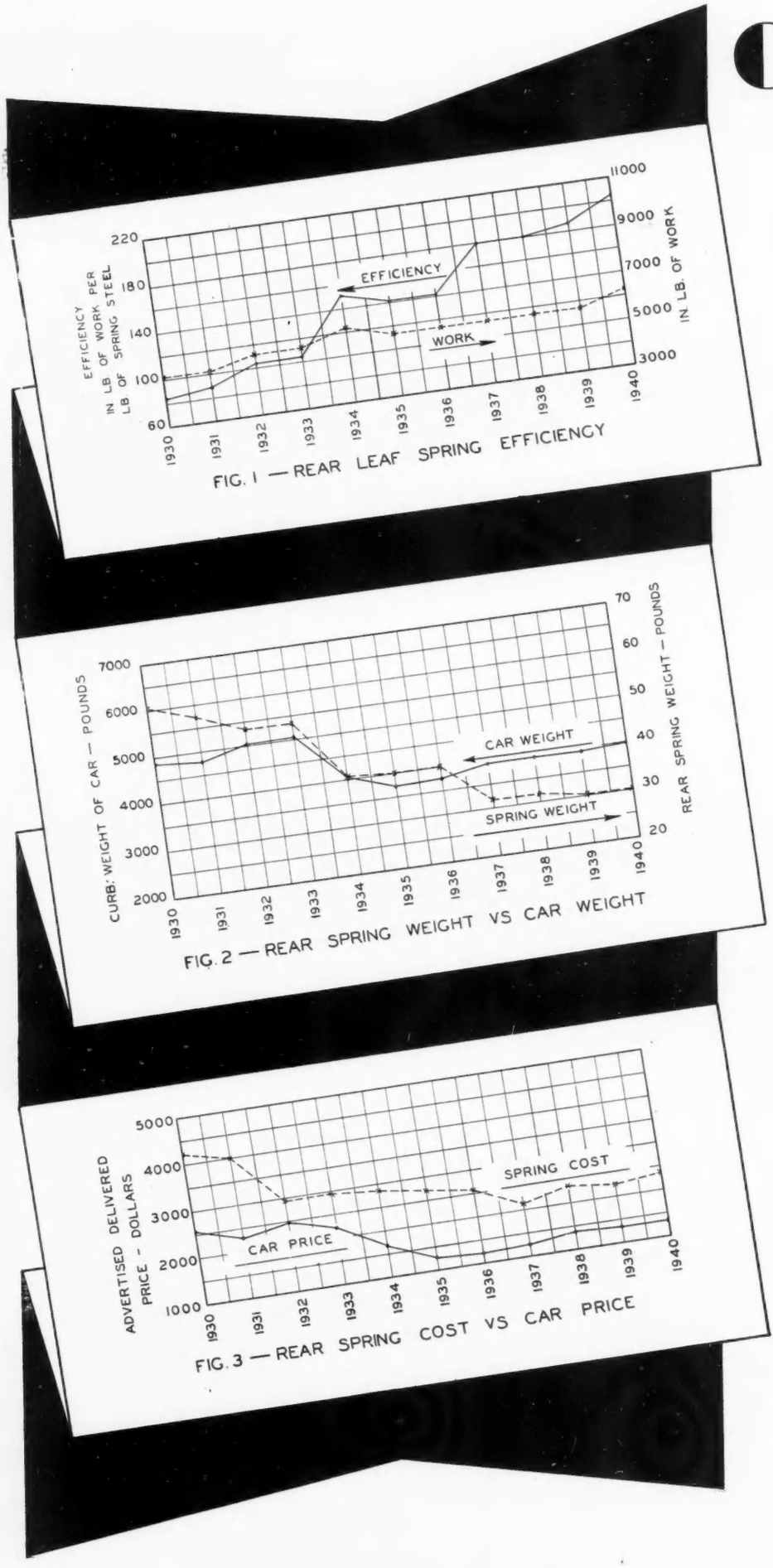


FIG. 1 — REAR LEAF SPRING EFFICIENCY

FIG. 2 — REAR SPRING WEIGHT VS CAR WEIGHT

FIG. 3 — REAR SPRING COST VS CAR PRICE

*Cadillac Motor Car Division, General Motors Corp.

Spring Efficiency and a Good Ride

mitted that today's cars are far superior in riding quality than the cars of, say, a decade ago; this granted, the discussion may be limited to spring development, and more specifically to spring development by the Cadillac Motor Car Division.

Paralleling the increase in comfort with modern suspension springs, there has been a gain in efficiency. This, together with improved action and longer life, is an achievement that is worth noting.

Cadillac used leaf-type semi-elliptic rear springs for many years. Between 1930 and 1940, as a result of spring development, the spring efficiency was increased in the ratio of 2.5:1 (Fig. 1). During this period the work done by the springs increased 20 per cent, which means that the present spring is doing more work with less than one-half the material (Fig. 2), and this in spite of the fact that in 1934 the drive was changed from the torque-tube to the Hotchkiss type, in which latter the spring also acts as a driving member.

Such a large gain, accompanied by improved spring action and appreciably longer life, could not have been made through changes in design alone. Credit is due to the steel makers, metallurgists, spring makers, and spring-liner manufacturers, all of whom have cooperated with the automobile engineer in the quest for greater spring efficiency.

The broad term "leaf-spring action" will be used to avoid technicalities, but it will be agreed that along with lower spring rates, spring action is an important factor in riding comfort. Little improvement was made in spring action until the adoption of spring covers filled with grease. With the steady trend toward lower spring rates, even this improvement did not give sufficiently consistent action, so interleaf liners and bronze inserts were added.

Although this latter innovation was basically sound, difficulties were encountered in the field, and a return was made to plain greased springs and covers. This move resulted in a certain amount of spring squeak trouble—a challenge to engineers to find a permanent corrective.

During the next two years great efforts were made to find a satisfactory interleaf liner. By 1936, with the aid of liner manufacturers, this problem was solved, and although liner life was not yet all that might be desired, the better spring action and trouble-free, silent operation warranted adoption of these liners. Improvements in the design of both springs and liners during the following two years increased liner life by more than 100 per cent, which was quite satisfactory.

Gains in spring efficiency are achieved by putting more of the material to useful work and working the material harder, which, of course, means increased stresses. Unless other changes are made, increased stresses in steel are always accompanied by shortened fatigue life. Cadillac has pioneered a number of such "other changes" which permit of increasing stresses without reducing spring life, and has been among the first to adopt others. It was the first automobile spring user to give up carbon steel for an alloy steel which possesses better physical properties. The use of a greater number of leaves of thinner gage resulted in another gain. Controlled-atmosphere furnaces, with

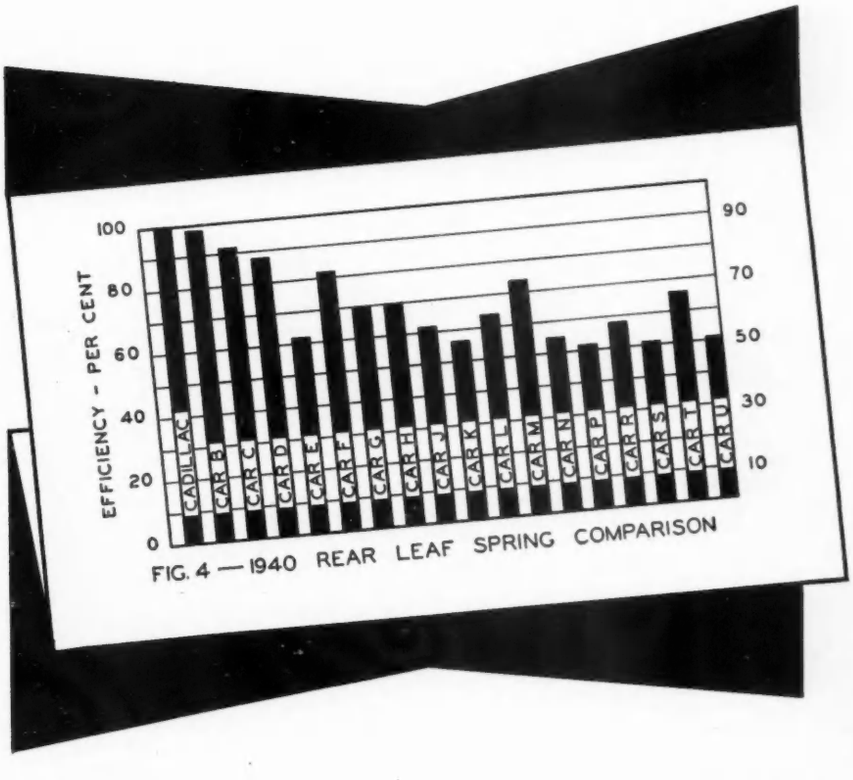


FIG. 4 — 1940 REAR LEAF SPRING COMPARISON

their more-nearly uniform results, and the early adoption of decimal-gage grading spelled further progress. Rubber pads at the spring seats reduced the amount of inactive spring material. A large gain resulted from the adoption of grooved-section spring leaves and interleaf liners, pioneered by Cadillac. Continual testing of springs with different grading, spacing and cambering of individual leaves brought considerable reward. Finally, shot-blasting of spring leaves, which was originated and pioneered by Cadillac, allowed a further gain in life with less material and lower cost.

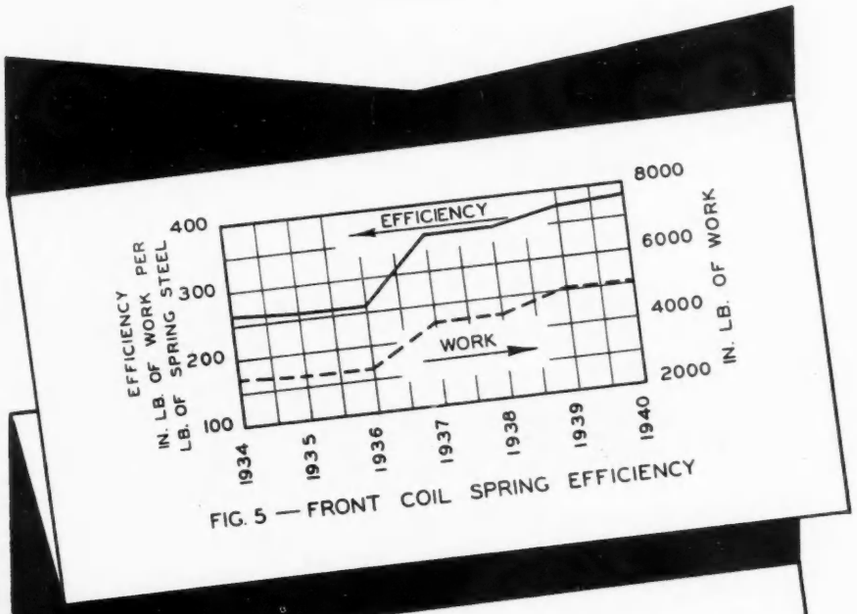


FIG. 5 — FRONT COIL SPRING EFFICIENCY

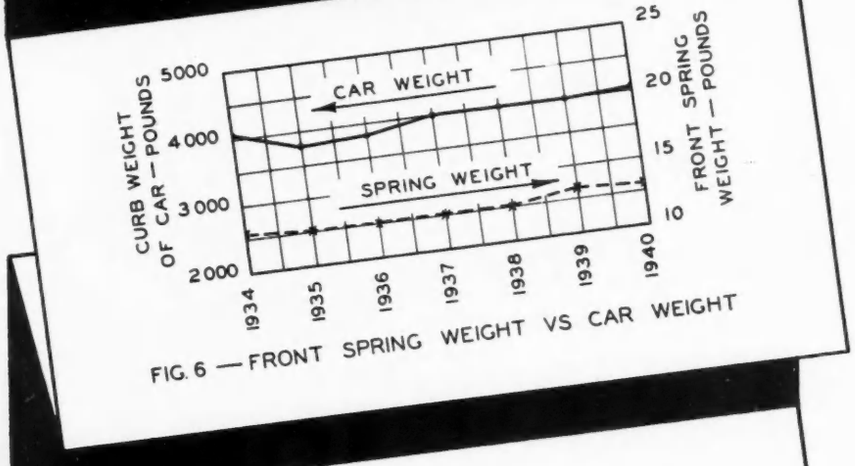


FIG. 6 — FRONT SPRING WEIGHT VS CAR WEIGHT

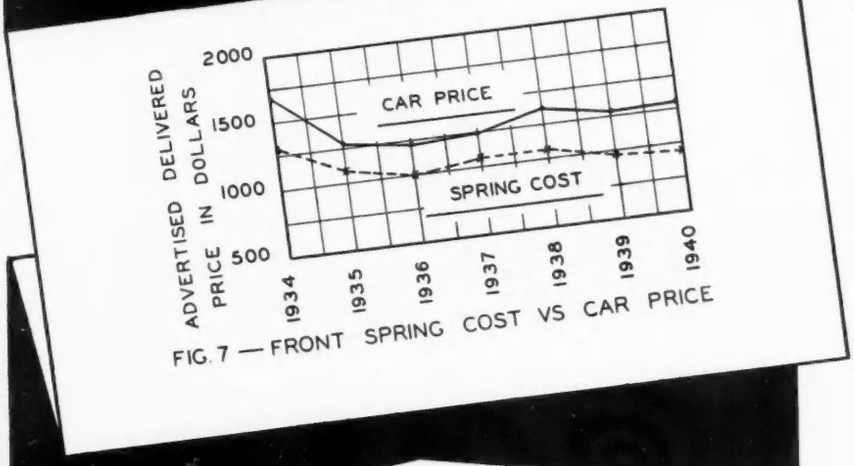


FIG. 7 — FRONT SPRING COST VS CAR PRICE

It may be of interest to compare rear-spring weights with car weights of the same period. This is done in Fig. 2, which shows that spring weights have dropped 30 per cent faster than curb weights of cars—another indication of the rapid progress made in spring efficiency.

Again, this reduction in spring weights might have been accomplished by very costly means, so a comparison of rear-spring costs with advertised delivered car prices seems apropos. Such a comparison is made in Fig. 3. Here the curves run more or less parallel, which shows that the reduction in car price has been accompanied by a reduction in spring cost. It should be borne in mind in this connection that the spring-cost is plotted on a piece-price basis. The cost per unit of work done is less than half what it was ten years ago.

Another interesting comparison is that of the Cadillac 1940 model with other 1940 cars, with respect to spring efficiency. In Fig. 4 the efficiency of the spring doing the most work per pound of steel is made equal to 100 per cent, and the others are rated accordingly.

So far the discussion has been confined to rear springs, for one reason because the same type of rear spring was used throughout the period. In the case of front springs the coil type was adopted in 1934. Previous to that time, semi-elliptic springs were used, in which the steel plates are subjected to bending. In the helical spring the wire is subjected to torsion. This is an important distinction which must be kept in mind when comparing spring efficiencies, and it explains why the definition was confined to a given type of spring.

It can be shown that for a given amount of work, a coil spring theoretically should weigh only 60 per cent as much as a leaf spring. (See note at end.) Actually it is even better than that, as it is

more nearly uniformly stressed and has less inactive material. One thing in favor of the leaf spring is that, in addition to performing its cushioning or suspension function, it can act also as a torque tube or radius rod, while with coil springs special members, such as wishbones or radius rods, are required. This makes the additional weight of the leaf spring more than worthwhile to the engineer.

Development work on coil suspension springs has been confined to a relatively short period. At the beginning, the problem was to get a trouble-free spring of long life as economically as possible. After wire finished by centerless grinding had been used for a number of years, it was found at Cadillac that much longer life and more nearly uniform results could be expected from wire that was shot-blasted after being ground. Upon the adoption of this process, stresses were increased and weight reduced, and the saving thus effected more than offset the cost of shot-blasting. Another year or two of development indicated advantages in the use of precision hot-rolled wire which required no centerless grinding. Here again Cadillac pioneered a successful development which permitted appreciable savings. Finally, improved methods of manufacture made possible elimination of the only grinding operation still performed on the springs, that on the end coils.

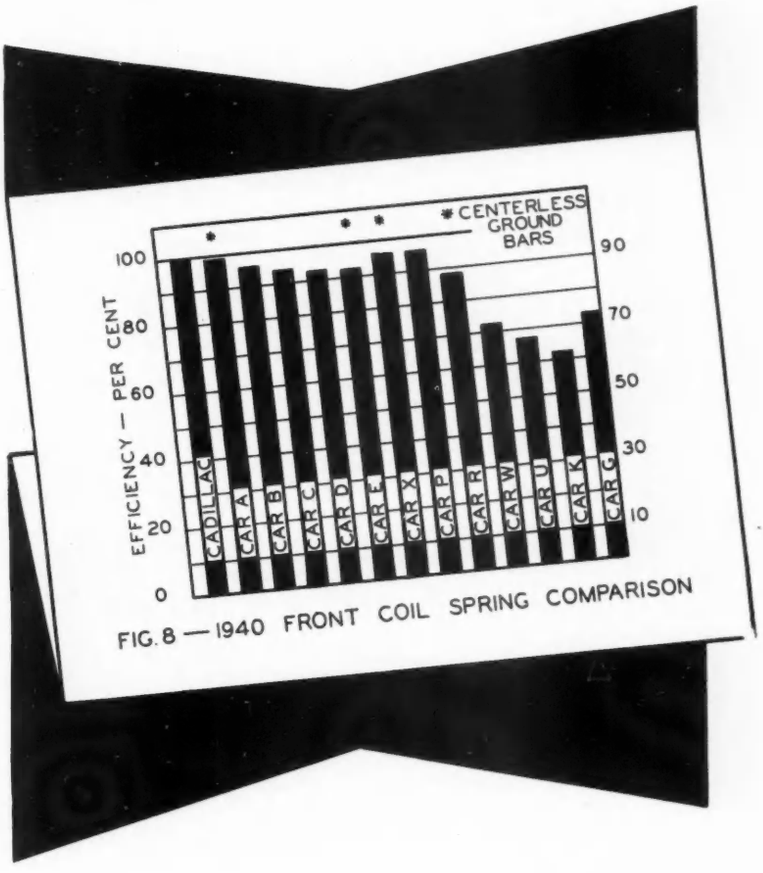


FIG. 8 — 1940 FRONT COIL SPRING COMPARISON

Fig. 5 shows that while the work done by the springs has been increased 45 per cent, the spring weight has remained practically constant (as shown in Fig. 6); hence the spring efficiency also has increased 45 per cent. The large increase in the amount of work done by the front springs is due to the fact that a larger proportion of the total weight is now carried by these springs and they also are softer. What Fig. 5 does not show is that even though the work has been increased and the efficiency improved, the fatigue life of the spring is definitely increased. All this was accomplished with less expensive material.

The marked rise in efficiency in 1937 was due to the adoption of shot-blasting, while the further gain in 1939 was due to better spring action, which is explained below.

In the wishbone-type front suspension, one end of the coil spring is fixed, while the other end is swung in an arc, which results in a buckling load in addition to the straight axial load. This bucking load causes increased stresses which reduce the fatigue life. By changing the spring geometry to reduce the "bowing" on the compression stroke, spring life was increased 48 per cent. This in turn permitted an increase in efficiency, which was incorporated in the 1939 Cadillac.

Improved design, better control of material from the steel mills, more nearly uniform heat-treating conditions, and improved manufacturing methods all added to the fatigue life of the spring. As stated previously, the greatest gains were the 68 per cent which resulted from shot-blasting and the further 48 per cent due to the improved spring geometry.

At Cadillac, improvements in design and production methods have been taken advantage of to achieve the best final result. A satisfactory spring life has been maintained, so that failure at no time has been a problem with this type of spring, and the savings which resulted from increased spring efficiency have been passed on to the customer. Today the life of coil springs is such that a further increase in spring efficiency would be warranted, and further economies could be effected, if it were not for the restrictions imposed by settling. It is this "settling" which has become the limiting factor and which has forced engineers to search for a better spring steel.

Fig. 6 shows that the weight of coil springs has closely paralleled the curb weight of the car. Fig. 7 shows that the cost of coil springs has dropped slightly faster than the advertised delivered car price. Fig. 8 is a comparison of the "coil-spring efficiencies" of different cars.

Since the work done per unit volume of material is equal to the stress energy which may be recovered (within the elastic limit), this gives another measure of the capacity of a unit volume of material to store stress energy, and is known as the modulus of resilience. The modulus of resilience (in a uniformly-stressed condition at the elastic limit) may be shown

(*Turn to page* 459, *please*)

Automotive MATERIALS 50

Cemented Brake Linings Are Appearing on Market

CONSIDERABLE interest is being displayed in a new method of applying linings to brake shoes without rivets. The linings are fastened to the brake shoes by an adhesive, which is not affected by heat, moisture or other service conditions, according to information now available. The advantage claimed for the new method is that it permits using the lining until practically the full thickness has worn away. With the usual rivet fastening, it is necessary to reline when the heads of the countersunk rivets are about to contact the drum, as such contact would result in scoring.

Another advantage of cementing the linings to the shoes is that it is not necessary to drill the shoes and lining, nor to countersink the latter. Although the cost of the rivets and of tools for making the holes and applying the rivets is eliminated, it is necessary to provide an adhesive and to use equipment for applying the linings to the shoes under pressure and in such a way that an enduring bond is assured. It is believed that bonding of the lining to the shoes over the entire area of contact will tend to eliminate one possible cause of squeaking brakes. One car manufacturer is reported to have some hundreds of sets of brakes with cemented linings under careful observation, and brake-service organizations are conducting investigations along similar lines.

The Asbestos Manufacturing Company, Huntington, Ind., is supplying Uni-Fuse, an asbestos-filled strip material containing adhesive for use in applying brake linings made by the company. These products are understood to be available to the industry for original equipment, as well as in relining.

S. G. Tilden, Inc., Brooklyn, is now equipped to apply its own make of Neo-Dine brake linings with an adhesive prepared by the company and called Permafuse, the combination being available only through its own service stations. Brake shoes with linings already cemented in place by the use of Permafuse and ready for installation by fleet owners in service replacements are also available. These shoes have the lining radius ground after application, to fit either standard drums or drums which have been reground to .030 in. oversize. Standard makes of linings applied by the Permafuse method to service shoes are expected to become available shortly.

Nonslip Rubberpull Prevents Belt Slippage

NONSLIP Rubberpull is the name of the new product that has been developed by the Nonslip Pulley Covering Co., Buffalo, for the purpose of preventing belt slippage. Tests have shown that it will increase the efficiency of belt drives as much as 50 per cent, company engineers state. Nonslip Rubberpull, which has a rubber base, is compounded so that it will stick to the pulley face even when subjected to extreme pulling conditions. It is supplied in liquid form and can be applied easily with a brush to the face of any pulley, flat or V-type. When applied at the end of the day, the pulley is said to be ready for use the next morning.

Improved Ignition Marker

AN IMPROVED ignition marker, suitable for aircraft and other engines, has been developed by the Irvington Varnish & Insulator Company, Irvington, N. J. The markers consist of lengths of insulated tubing, varnished both inside and outside, on which suitable identification marks are screen-printed. The marker is furnished in standard lengths which are slipped over the wires to be identified.

This latest form of marker is an improvement over an earlier one, in which the identification letters and numerals were printed on cellophane strips, which in turn were fastened to the insulating tube. The new markers are available in two inside diameters of 0.263 and 0.294 in. (nom.), with either of two heights of symbols, and in two standard lengths. These markers and their numerals and letters are said to be in accord with both American and British aviation standards.

Lead Alloy as a Substitute in Die Castings

ACCORDING to H. H. Doehler, chairman of the board, Doehler Die Casting Co., the company as one of the principal producers of antimonial lead die castings is recommending the use of the alloy as a substitute for high-purity zinc alloy die castings for all ornamental parts of vehicles where zinc die castings are currently employed. Doehler makes a special point of the fact that the substitution of the lead alloy is recommended only as an emergency measure and purely as a temporary expedient since it is recognized that the zinc alloy die castings are superior in most respects and, incidentally, less expensive to produce.

Chief reason for recommending the lead alloy at this time is to permit the continued use of die castings. It is important to note in the interest of national defense that the same dies can be used for both the

zinc and lead alloys so that no new die equipment is made necessary thereby. Moreover, if any new parts are designed for die casting, the dies can be used for zinc alloy production when zinc becomes available for general use. It is claimed, too, that the lead alloy parts have excellent plating quality so that there will be no depreciation in eye appeal when used in passenger cars. It is recognized that the lead alloy is inferior in physical properties and for that reason it is recommended only for a certain range of more or less decorative parts.

According to Doehler, some motor car and parts producers already have adopted their recommendations for using lead alloy die castings for the following parts formerly made of high purity zinc: Radiator ornaments, fender ornaments, radio grilles, instrument panel parts, horns and some minor parts.

In addition, Doehler is recommending the use of lead alloy for the following parts: Headlight frames, rear light frames, name plates, molding of all kinds, and small grilles.

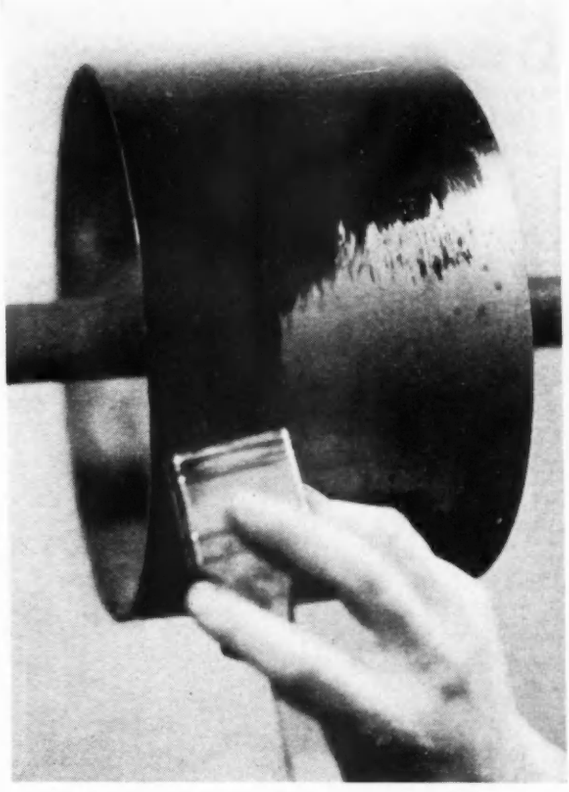
Since high purity zinc alloy is extremely sensitive to contamination by foreign materials, special arrangements must be made for handling the lead alloy production so as to prevent interference with the manufacture of zinc alloy die castings for defense purposes. To this end, Doehler has provided specially equipped and completely isolated die casting departments in Toledo and Batavia.

While it is recognized that the substitution of the antimony-lead alloy for high purity zinc is only in the nature of an emergency measure, within a restricted sphere of use this expedient will make it possible to continue the use of the die-casting process with its unquestioned advantages until the zinc alloy material is again made available. Unquestionably, too, the ability to continue the use of available die casting equipment without resorting to entirely new methods offers advantages which cannot be overlooked in the present emergency.

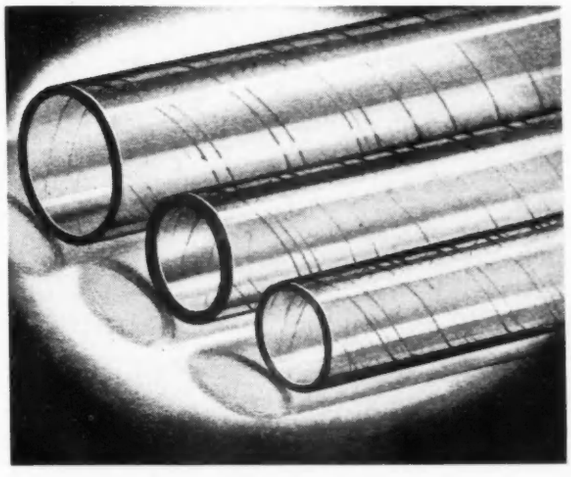
Improved Harvel Insulating Varnish

A NEW formulation of Harvel 612-C insulating varnish has been announced by Irvington Varnish & Insulator Co., Irvington, N. J. This is a phenol-formaldehyde synthetic-resin-base varnish, made from cashew-nut-shell liquid, which polymerizes on baking to an infusible, insoluble state. It is claimed to solidify throughout on drying, leaving no gummy half-cured interiors, as its solidification does not depend on oxidation. Improvements resulting from the new formulation are said to include speedier curing and flexibility adequate to withstand all stresses due to thermal expansion and contraction of the windings. It resists vibration, bonding the conductors into a compact mass. This new 612-C is said to retain its insulating strength well at high operating temperatures, such as are encountered with Fiberglas insulation.

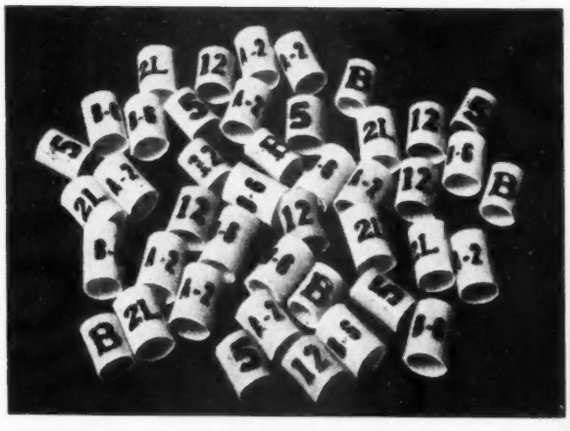
(*Turn to page* 458, *please*)



Applying Nonslip Rubberpull to pulley



Transparent acetate tubing a new product of the Precision Paper Tube Co., Chicago



Ignition wire markers

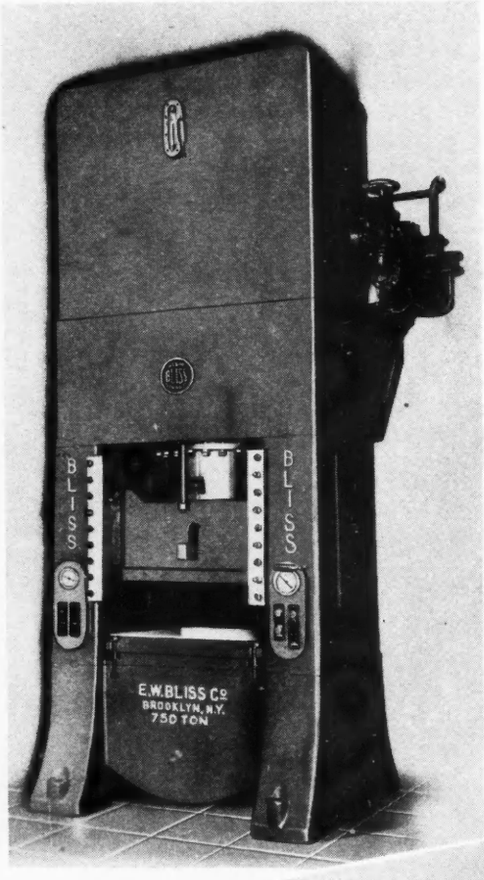
MATERIALS

A RECENT development of the E. W. Bliss Company, Brooklyn, N. Y., is the enclosed-design, 750-ton Hydro-Dynamic press illustrated herewith. It has an intermediate pressing cylinder which gives a higher speed at low pressures (under 350 tons), yet has available a maximum pressing capacity of 750 tons (at normal pressing speed). This feature is of value in deep-drawing work which is finished with a coining operation, the press then operating at high speed throughout the drawing portion of the stroke and automatically changing over to the normal pressing speed after 350 tons pressure is reached.

With the pumping unit supplied with this press the following press speeds are obtained:

665 in. per min. quick advance speed
56 in. per min. pressing speed up to 350 tons
27 in. per min. for from 350 to 750 tons
720 in. per min. return speed

The frame is of the four-piece, fully-shrunk, steel tie-rod type. Bed, uprights and crown are cross-keyed together, which enables the frame to take torsional and off-center loads. Universal, all-electric control is available for both production operations and die-setting. Speed change and reversal of the press slide may be controlled by either position or by pressure in the system. The electric control devices are concealed in the side housing, where they are protected. An adjustable bar knockout is furnished in the slide, while the bed is arranged for a liftout or a cushion.



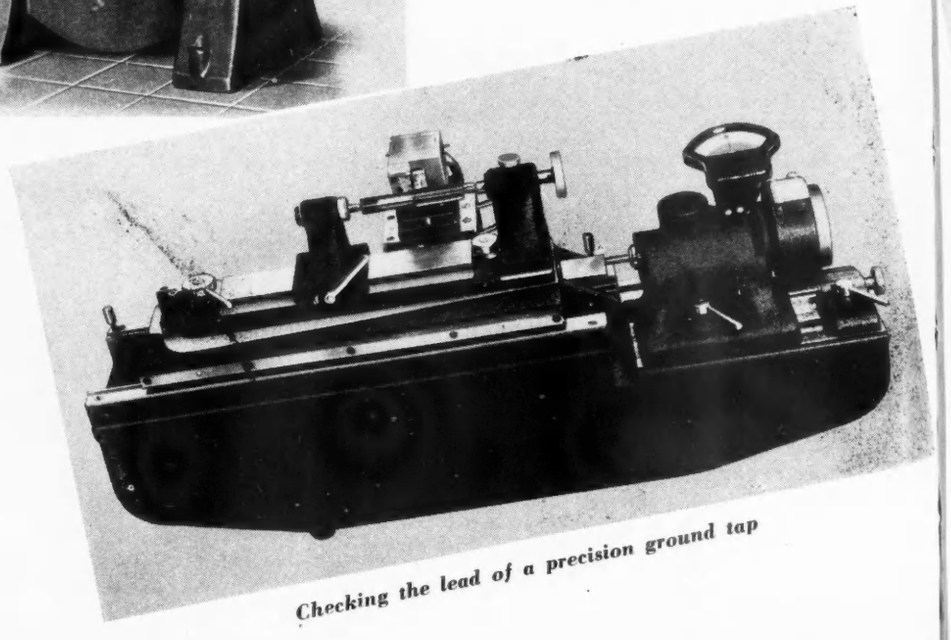
Bliss 750-ton high speed Hydro-Dynamic press

AN INSTRUMENT for checking thread leads, which is said to make possible great accuracy, speed, range and flexibility, has been announced by Pratt & Whitney, West Hartford, Conn. It occupies a bench space of 37 by 17 in. and is 15 in. high. It will handle parts up to 4¾ in. in diameter, with a thread length of 4 in. and an over-all length of 8 in. The measuring head is identical with the one on the P & W Standard measuring machine, except that the microscope is omitted. It is claimed to read accurately to within 0.000025 in. Taper threads as well as straight threads may be checked by correctly positioning the swivel work-supporting table.

The illustration herewith shows checking the lead of a ground tap. Movement from one thread to the next is obtained by using the three index dials on the measuring head for inch fractions, and Hoke precision gage blocks for even inches. A 4-in. Hoke block is shown in position. In this case the reading would be 4 in. plus whatever fraction of an inch shows on the three dials. A ball point contacts the threads and operates an Electrolimit gage head and microammeter to give the zero position for any thread.

A 12-oz. single-nozzle plastic injection-molding machine has been designed and built by the Hydraulic Press Manufacturing Company of Mount Gilead, Ohio, and we are informed that several of these presses already have been tested under production conditions by injection molding

MEN



Checking the lead of a precision ground tap

companies. It is believed by the company that owing to the scarcity of such metals as zinc and aluminum, die castings will be largely replaced by moldings in the near future and that injection molding will be preferred to the older compression molding because it permits more rapid production, saves on cost of molds, and reduces finishing operations.

The H-P-M 12-oz. hydraulic machine embodies a straight-line hydraulic clamp which assures positive closing of the mold halves and automatically adjusts for molds of any thickness, thereby reducing set-up time. Uniform heating of the plastic material is ensured by a circulating fluid-heating system, and this is said to eliminate flow marks and discoloration in the finished product. Force feed of the material, together with a positive measuring feature, permits the use of the 12-oz. capacity press for producing smaller moldings.

This press is equipped with the standard H-P-M Hydropower radial-piston-type pressure generator. It is claimed that the only maintenance required by this pump is that after a certain number of running hours, the tapered roller bearings that separate the vital working parts must be taken up for wear, and this can be done without dismantling the pump. The basic specifications of the press are as follows:

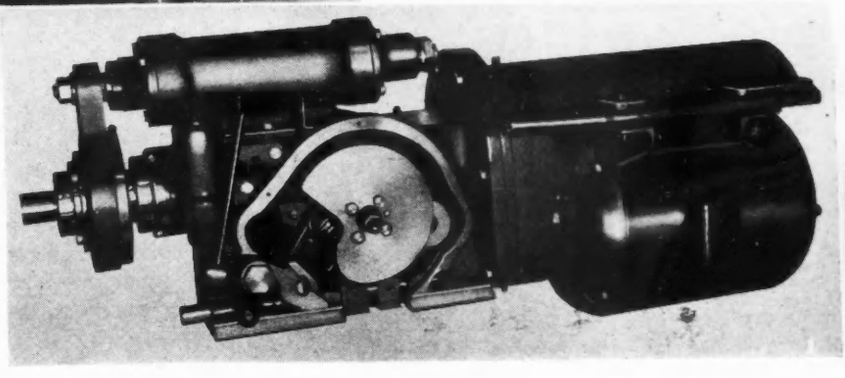
Clamp pressure	200 tons
Maximum mold size	16½ by 24 in.
Minimum shut height of mold	6 in.
Maximum opening between platens (open position)	18 in.
Maximum stroke of mold carrier platen	12 in.
Maximum weight of material injected (one cycle)	12 oz.
Pressure per square inch on material in injection chamber	30,000 lb.

THE Enterprise Machine Parts Corporation, Detroit, has bought the patent rights to the Millholland unit mechanisms and is now building and marketing them under the name "Empco." Empco units lend themselves to application to drilling, milling, tapping, reaming, and spot-facing (either singly or in multiples), and are used to form machines for speedy production. The cam, which makes use of a pneumatic counterbalance, is said to have a chip-cutting efficiency of 80 to 85 per cent, which means the idle time has been reduced to a practically negligible proportion. It is claimed that, owing to the use of plate-type cams, simple feed, and speed gears, and to the interchangeability of the same size units and parts, change-overs can be made at minimum cost.

and MACHINES

H-P-M 12-ounce plastic injection molding press

THE NEW Rego economizer No. 4360 of the National Cylinder Gas Company, Chicago, Ill., is designed for use with aircraft torches or injector-type welding torches. Where welding operations are intermittent or where the torches are on and off due to work set-ups, they are claimed to save up to 30



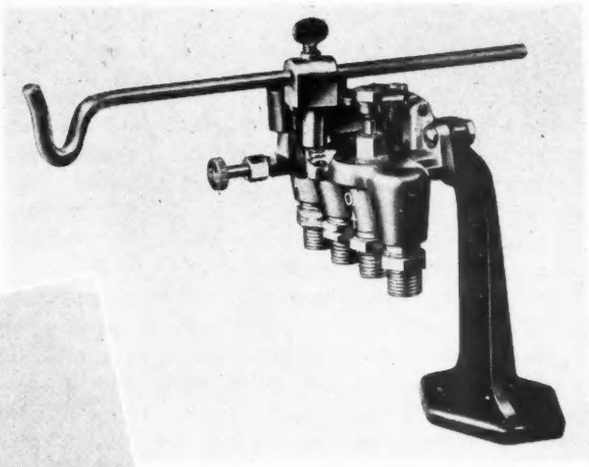
Empco unit mechanism

MEN AND MACHINES

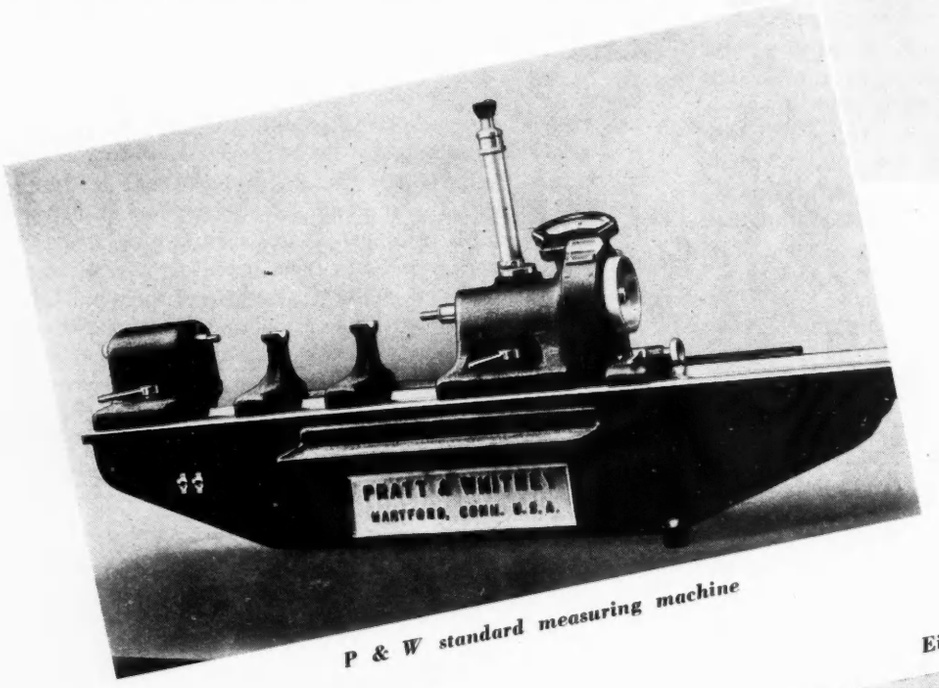
per cent on gas and operator time. The shut-off is said to be fast and positive, due to the type of diaphragm shut-off valve used. Body and diaphragm bonnets of the economizer are heavy bronze forgings.

Model 4360 is designed for very light-weight torches and for torches which operate at unbalanced gas pressures. The shut-off valves on the lever arm assembly are equipped with adjusting screws which, when set for the torch pressures being used, assure correct seating; an extendable lever arm provides the adjustability required to assure positive shut-off with torches weighing only a few ounces. This model is claimed to operate with gas pressures as unbalanced as 3 oz. acetylene pressure with 50 lb. oxygen pressure; to give good performance with torches which operate at equal or balanced pressures up to 25 lb.; and by adding a weight to the lever arm, it will handle balanced pres-

(*Turn to page* 449, *please*)

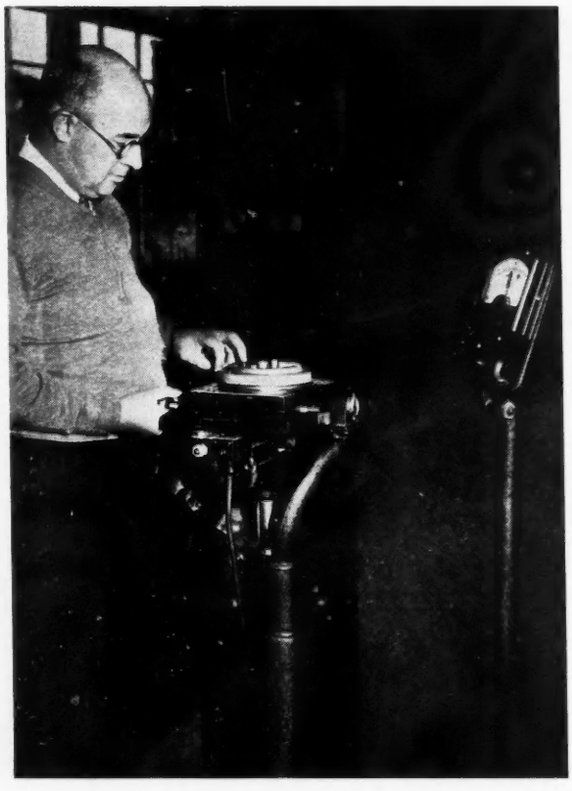


Rego gas economizer



P & W standard measuring machine

Eisler multiple spot-welder



P & W Electro-limit universal internal comparator

PRODUCTION LINES

Ground Threads

One of the most difficult problems in launching a new product, particularly if it is a machine tool, is to find its most likely and most economical applications. That was a part of the early experience with the Precision Thread Grinder launched by Ex-Cell-O but a few years ago. Since then the thread grinder has become indispensable in aircraft engine manufacture, even more so since the tempo of national defense has quickened. However, the future development of this technique will depend upon extensive applications in the automotive industry—in the making of motor cars and trucks and parts. A recent issue of *Tool Tips* cites an interesting example along this line. It notes that both the nut and the screw of the Saginaw recirculating type steering gear are precision ground, the nut being ground on a new Ex-Cell-O internal grinder. As readers of this page well know, the recirculating gear is used as standard equipment on Cadillac and Buick cars.

Resists Wear

It has been some time since we made reference to the use of wear-resisting chemical coatings as typified by the Parker Rust Proof process and the variety of other treatments adopted so extensively in the industry. That does not mean that the application of chemical coatings has come to rest. A recent note from Chevrolet indicates that the manganese-phosphate coating adopted for the treatment of camshaft cams in 1940 now has been extended to the engine rocker arms and the shifter yokes of three-speed transmissions.

For Shipping

Although a shipping crate is a pretty prosaic item in the manufacturing field, engineering research coupled with an intimate knowledge of materials handling has unfolded some important economies that are well worth noting. We refer particularly to the new metal-bound shipping containers developed by the General Box Co. for handling freight shipments from an auto plant to its assembly plants, from parts makers to auto plants and warehouses, etc. These husky containers save handling at each end, make it possible to transport materials right to the point of usage on the assembly line without extra handling and without uncrating. Engineering research applied to a seemingly prosaic problem has unfolded many unplumbed possibilities of value to our industry.

Quick Returns

When it comes to the normal amortization of machine tools, it's quite a problem to force a machine tool to pay for itself in a year or 18 months. The other day we ran across a specialized piece of equipment which is said to pay for itself in two or three months, despite the fact that first cost exceeds that of most commonly-used machine tools. We refer specifically to the AEF tubing mill which produces welded steel tubing from strip stock, automatically. When this type of machine is used intensively it pays for itself in an amazingly short time—one recent installation is said to have been amortized in three months. Where there is sufficient demand for welded steel tubing, it provides an unfailing source of supply of a variety of special sizes, and in some instances puts a parts maker in the tubing business.

Improvised Methods

At the Defense meeting of the ASME in Cleveland, George T. Trundle, Jr., emphasized a vital point with respect to National Defense, namely, the urgent need for full speed ahead without further overloading the already overburdened machine tool facilities. His solution is impress into use all manner of old and perhaps obsolete machine tool equipment, now in the plants of contractors, sub-contractors and in the warehouses of machinery dealers. Such equipment can readily take up much of the slack, if placed in operating condition, and properly tooled. Much of the older machinery can be put to good use even if it is not considered good enough for precision work by ear-marking it for roughing operations. (In fact this principle is in effect in some plants—witness the article on Buda-Guiberson production which was published in AI, April 1.) Another point well taken is that of employing universal type equipment such as engine lathes, milling machines, planers, etc., right on mass-production line-ups, properly tooled for single-purpose operations. One effect of this device would be the ability to man such machines with relatively unskilled labor, despite the fact that when used as universal machines they would require skilled mechanics for their operation. The nub of the idea is admirable when applied to the present emergency. We commend it to management executives.

Close-Ups

Recently we saw a private showing of some special films made by the General slectric Co. to demonstrate what happens when metal is cut. The film was taken with a high-speed camera set for 1000 frames per sec. Most of the operations show the cutting of steel, cast iron, and brass on a milling machine. By this means of slowing down the process, it is possible to see clearly the effect of variations in tool form, of sharp and dull cutters. Too, it is possible to see the distortion of the work surface due to the cutting action. One of the most dramatic features of the demonstration is the ability to see the actual wind-up (torsional deflection as well as back-lash effects) in the heavily loaded work spindle. As revealed by the unfailing eye of the camera, spindle wind-up produces an instantaneous stoppage of cutter rotation, resulting in a frequency of hammer blows on the point of the tool. Production men and technical men in general will find pleasure in viewing this unusual film. G.E. will be glad to loan the film to any interested group, upon application.

Standard Fits

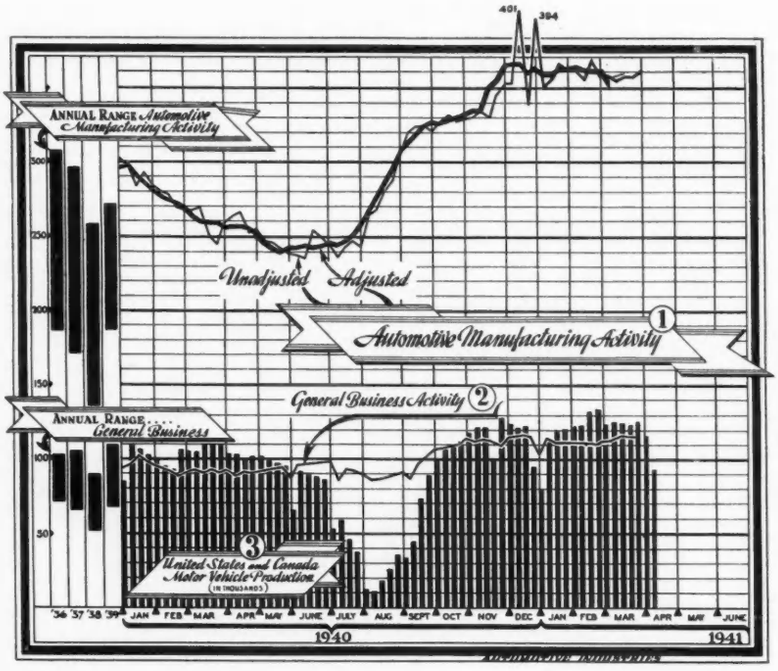
A booklet containing a complete discussion of the problem of standardizing cylindrical fits has been published by the American Standards Association. The material proposed by John Gaillard is presented in four brief sections —the simplified problem; influence of tolerances; control of fits, and the National and International systems of fits. Engineers and factory executives will find this discussion of real interest.

Powdered Metal

Unique properties are exhibited by a new powdered metal composition combining iron-nickel-moly. The resulting material has high magnetic permeability with practically no hysteresis loss and no residual flux. It was developed for a specific application where such properties are essential. Maybe there are other places where this material can be of value.—J. G.

BUSINESS IN BRIEF

[*Our own view of automotive production and sales; authoritative interpretation of general conditions*]



Weekly indexes of automotive general business charted

Total Output Falls As Ford Shuts Down

PRESAGING the first major downward trend in automobile production since the first of the year, the total dropped sharply during early April as the strike of the UAW-CIO at the Ford Motor Co. River Rouge plant closed down a manufacturer that accounts for more than 20 per cent of U. S. and Canadian output. Although estimates necessarily are tentative due to the uncertainty over the possible length of the Ford strike, it is estimated that production for the first half of April will be 224,000 units provided a Ford settlement is not reached by April 15.

Even with Ford resuming production in the latter half of April, it is doubtful if the month's output will exceed the 452,433 units assembled in the same month last year. Production for the week ending April 12 declined to approximately 97,000 vehicles, the lowest for any week since the Christmas holidays, compared to 113,500 units in the previous week. Output was expected to maintain about the same level for the week ending April 19, although a Ford settlement would boost the figure by 4000 to 5000 units daily.

General Motors turned out an estimated 54,900 motor cars and trucks in the week ending April 12, Chevrolet's total being increased as the 16-day strike that held up production at that division's Oakland, Cal., plant was terminated. Chrysler divisions accounted for 24,700 vehicles. Studebaker led the independents followed by Nash, Hudson and Packard. The Ford strike called April 1 at the vast River Rouge plant also resulted in closing of all 16 Ford assembly plants and the Lincoln plant by April 7 due to a shortage of parts. Ford dealers were reported stocked with about a month's supply of new cars.

Production in U. S. plants for March was estimated at 512,150 units by the Automobile Manufacturers Association. This marked an increase of 20 per cent over March, 1940. February production for the U. S. and Canada totaled 509,233 units by Department of Commerce tabulations and helped set a new record of approximately 1,565,000 units for the first quarter of 1941, breaking the 1929 mark by nearly 20,000 units.

Climaxing a record first quarter, March retail sales set new high marks for that month. General Motors retail deliveries of 253,282 motor cars and trucks during March were the greatest for any month in the corporation's history. The previous record of 200,117 was set in April, 1936.

Studebaker and Nash also set new first quarter records, the former delivering 30,298 vehicles, up 35 per cent from 1940, while Nash deliveries of 26,193 units were 100 per cent above a year ago and beat the 1929 record. DeSoto and Dodge both enjoyed the biggest retail sales for a single month in their history, while Chrysler and Plymouth established new March records. Packard preceded the introduction of its new Clipper model with the biggest month's sales since June, 1937. Willys' deliveries were up 30 per cent.

[1] 1923 average = 100; [2] Prepared by Administrative and Research Corp. of New York. 1926 = 100; [3] Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.

NEWS OF THE INDUSTRY

NLRB Opens Way for Union Control of Ford Workers

Collective Bargaining Elections Ordered at Big Rouge and Lincoln plants before May 22; Outlaw Company Brotherhood

The collective bargaining election which must be held before May 22 at the Ford Motor Co. River Rouge plant will be the largest such election ever held in a single plant. The NLRB ordered the election in Washington April 7 for the 85,000 Ford Rouge workers after a 3-day hearing in Detroit the previous week. All maintenance, production and clerical employes can choose between the UAW-CIO, a federal local of the UAW-AFL or no union. A similar election was ordered at the Lincoln plant, employing 3500, with the same choice of unions, while the 400 wood and metal patternmakers at the Rouge plant can choose between the Pattern Makers League of America (AFL), the UAW-CIO and no union. The Ford Brotherhood, formed June 3, 1937, to combat UAW-CIO organizing efforts, was denied a place on the ballot because there had been no new members signed or membership meeting held since.

By April 7 the 5-day old Ford strike had made 118,000 Ford workers in various parts of the country idle. These included the Lincoln and Highland Park plants in Detroit, 16 assembly plants throughout the nation, and the small "village industries" in southeastern Michigan, all of which are dependent upon the Rouge plant for supplies. The strike was costing the 85,000 Rouge workers $640,000 daily in wages. In addition, several thousand workers at other plants that supply Ford with 7000 items also were made idle. These include Kelsey-Hayes Wheel Co., Ainsworth Mfg. Co., Motor Products Corp., L. A. Young Spring & Wire Co., and many others. Ford purchases average $11,000,000 per week from suppliers. Movement of 1350 freight cars daily to and from the plant was halted.

Considerable damage inside the plant was done by strikers before they marched out, according to company reports. Heats of steel in two of the 10 open hearth furnaces were allowed to solidify and some molten steel ran out on the mill floor. The furnaces will require a month or more to repair when operations are resumed. Damage also was reported done to machinery in the tool and die building due for installation in the new airplane engine building. Construction on the latter was halted when AFL craft unionists were unable to continue work.

Union Demands Cited

Demands of the union included immediate reinstatement of all workers discharged for union affiliations, a general wage increase of 10 cents per hour to bring wages to the level of GM and

Washington Contact Office

Jesse Jones, Secretary of Commerce, has opened a Service and Information Office in Room 1060, Department of Commerce Building, Washington, D. C. It is designed to assist business men who come to Washington but do not have their own contacts or do not know to which Government office they should go.

The new Service Office is staffed with men detailed from the Bureau of Foreign and Domestic Commerce and others with long experience in Washington with Government affairs. Those contemplating a Washington trip can have their appointments arranged in advance by getting in touch with the Service and Information Office.

The Brass-Hat Rack

"It's all right, boss—we're just voting to see whether we'll hold our dance next Saturday night!"

Speeding Up the Organization of Ford Workers

Associated Press Photo

Chrysler, establishment of a seniority system to govern lay-offs and a shop steward system to handle grievances, abolition of the Ford spy system and the service department. Harry Bennett, Ford personnel chief, quoted Henry Ford as saying that the eight men, rehired in March through efforts of Dewey and fired in the dispute which provoked the strike, would never again work for the company. Bennett also charged Communistic influences with fomenting the strike. Michael F. Widman, Jr., chairman of the Ford organizing drive, and Roy W. Thomas, UAW-CIO president, directed the strike.

Allis-Chalmers Reopened

The 76-day strike at the Allis-Chalmers Mfg. Co., Milwaukee, which began Jan. 22 in a dispute over union recognition, came to an end April 8 when 7800 workers returned to the plant. Work was planned on a 24-hr.-day basis in an effort to speed production of $45,000,000 in national defense orders, including vitally important generators for army powder plants and propulsion machinery for navy destroyers. The Defense Mediation Board, to which the strike was certified April 3, effected a settlement three days later. This later was ratified by the UAW-CIO. The settlement provides for a continuing contract, with a 30-day cooling off period for negotiations in any dispute. Cases involving shop discipline will be referred to an impartial referee. A blanket wage increase remains to be negotiated. On the crucial question of union security, "It is agreed . . . that the fact that an employe is not a member of the union or is not a member in good standing shall not alone and in itself be cause for discipline in the absence of some other fact. . . . It is expected that by union members remaining in good standing . . . interference with shop discipline will be reduced."

A 16-day strike in four General

Is this coercion? Is this intimidation? Is it, for the worker being beaten, an opportunity to exercise "that freedom of choice and action which is justly his" according to our President's interpretation of the law? Or is it assault and battery to collect union dues and to hell with law and order and national defense?

About such current goings-on, W. S. Knudsen said recently: "Strikes like (that at) Ford are purely for the purpose of speeding up the union organization effort in the plants. The Allis-Chalmers strike * * * at least technically, was called without the consent of the membership. The fact that 4,000,000 hours of time is lost in order to find out what happens to a union man who isn't paying his dues was not even important—the important part was that the radical leaders * * * could show the State and the nation where to get off."

Motors plants at Oakland, Cal., which stopped Chevrolet assemblies on the West Coast and made 2250 men idle, was settled April 4. Of 26 UAW-CIO welders in the Fisher Body plant who were dismissed for an unauthorized work stoppage, 24 were rehired and the cases of the other two were referred to the GM referee, Dr. George W. Taylor.

Settlement was effected by Federal Mediator Dewey, March 29, in a 19-day strike at the Midland Steel Products Co., Detroit, maker of automobile body frames. On the crucial issue of piece work, whose abolition was sought by the UAW-CIO, a compromise was achieved calling for a guarantee of earnings 18 per cent above newly established piecework base rates. The base rate was raised 5 cents, while hourly rated workers were given a 5-cent-an-hour raise. It was estimated that the raises would amount to $300,000 annually for 1700 workers.

The strike at the Federal Motor Truck Co., Detroit, which has $5,000,000 in army truck orders, also was ended March 29. The agreement provides for a blanket 5-cent-an-hour wage increase, Christmas bonus of a week's pay and improved seniority and grievance machinery. On the disputed issue of a closed shop sought by the UAW-CIO for 350 production workers, the new contract calls for "mutually satisfactory assurances from both management and the union to safeguard established working relationship."

CALENDAR

Conventions and Meetings

American Chemical Society, St. Louis, Midwest Power Conference Chicago, Chamber of Commerce of the U.S.A., Annual Meeting, Washington, D.C., Apr. 29-May 1
American Gear Mfg. Assoc., Hot Springs, W. Va. ..... May 5-7
National Metal Trades Assoc., Chicago, May 8-9
American Foundrymen's Assoc., New York ..... May 12-15
Western Metal Exposition and Congress, Los Angeles ..... May 19-23
Aluminum Assoc. (Summer Mtg.) Cincinnati ..... May 20
American Iron & Steel Institute, New York ..... May 22
American Battery Manufacturers Assoc., Detroit ..... May 22-23
Automotive Engine Rebuilders Assoc., Pittsburgh ..... May 22-24
Society of Automotive Engineers, Summer Meeting, White Sulphur Springs, W. Va. ..... June 1-6
Eastern Photoelasticity Conference, Cambridge, Mass. ..... June 12-14
American Society for Testing Materials, Annual Meeting, Chicago.... June 23-27
Natl. Petroleum Assoc., Atlantic City, Sept. 17-19
Society of Automotive Engineers, National Tractor Meeting, Milwaukee, Sept. 25-26
Society of Automotive Engineers, Aircraft Production Meeting, Los Angeles ..... Oct. 30-Nov. 1

Shows

Automotive Trade & Accessories Show, Boston ..... May 1
Automobile Accessories Association Show, Chicago ..... Aug. 4-7

New Passenger Car Registrations and Estimated Dollar Volume by Retail Price Classes*

PRICE CLASS	JANUARY, 1941-1940							
	NEW REGISTRATIONS				ESTIMATED DOLLAR VOLUME			
	Units		Per Cent of Total		Dollar Volume		Per Cent of Total	
	1941	1940	1941	1940	1941	1940	1941	1940
Chevrolet, Ford and Plymouth	158,458	141,756	53.00	54.48	$128,757,000	$108,300,000	46.62	47.92
Others under $1,000	54,771	83,285	18.32	32.01	50,652,000	75,600,000	18.34	33.45
$1,000 to $1,500	79,774	32,797	26.68	12.60	86,349,000	37,300,000	31.26	16.51
$1,501 to $2,000	4,716	1,449	1.58	.56	7,414,000	2,500,000	2.68	1.11
$2,001 to $3,000	1,258	899	.42	.34	3,029,000	2,200,000	1.10	.97
$3,001 and over	.....	16	.....	.01	.....	80,000	.....	.04
Total	298,977	260,202	100.00	100.00	$276,201,000	$225,980,000	100.00	100.00
Miscellaneous	202	14	.....	.....	.....	.....	.....	.....
Total	299,179	260,216	100.00	100.00	$276,201,000	$225,980,000	100.00	100.00

* All calculations are based on delivered price at factory of the five-passenger, four-door sedan, in conjunction with actua new registrations of each model. The total dollar volumes are then consolidated by price classes.

New Truck Registrations*

	January 1941	December 1940	January 1940	Per Cent Change January 1941 Over 1940	Per Cent of Total January	
					1941	1940
Chevrolet	20,144	19,119	15,997	+ 26.0	32.65	35.05
Ford	16,175	14,781	13,282	+ 22.0	26.21	29.10
G. M. C.	9,163	3,477	3,142	+192.0	14.85	6.88
International	7,573	5,646	5,538	+ 37.0	12.27	12.13
Dodge	4,499	4,182	4,345	+ 3.8	7.29	9.52
White	909	901	422	+117.5	1.47	.92
Plymouth	866	769	718	+ 20.8	1.40	1.57
Mack	674	630	572	+ 17.6	1.09	1.25
Diamond T	447	408	536	- 16.8	.72	1.17
Studebaker	231	122	85	+172.0	.37	.19
Autocar	189	149	143	+ 32.0	.31	.31
Brockway	155	135	117	+ 32.4	.25	.26
Divco	145	162	143	+ 1.3	.23	.31
Federal	125	134	153	- 18.3	.21	.34
Willys-Americar	82	107	173	- 52.6	.13	.38
Reo	81	94	11	+636.0	.13	.02
Hudson	65	75	56	+ 16.0	.11	.12
Sterling	34	28	22	+ 54.5	.06	.05
F. W. D.	15	15	27	- 44.4	.02	.06
Bantam	11	4	38	- 71.0	.02	.08
Miscellaneous	129	157	130	- 0.8	.21	.29
Total	61,712	51,095	45,650	+ 35.1	100.00	100.00

* Includes Federal Government deliveries.

Midgley Awarded The Priestly Medal

Dr. Thomas Midgley, Jr., of Worthington, Ohio, and vice-president of the Ethyl Gasoline Corp., has been awarded the Priestly Medal—highest honor of the American Chemical Society—for both "outstanding achievement in chemical science" and for personal courage.

Credited with the invention of ethyl gasoline, Dr. Midgley has been making a heroic fight against infantile paralysis with which he was stricken six months ago. He is chairman of the board of the American Chemical Society and a member of the National Inventor's Council.

Tires Under Export Control

The federal export control board has placed all types of rubber tires under export license control, effective April 15. Exports will not be cut off, but it was predicted in Washington that all types of airplane and automobile tires consigned to the Axis countries or likely to be reshipped to them, will be refused permits.

U. S. deliveries of automotive casings during February, 1941, totaled 4,910,365 units according to statistics released by The Rubber Manufacturers Association, Inc. This is 1.3 per cent more than the January shipments and 19.4 per cent above February, 1940.

Curtis to Head ASTE in 1941

At the meeting of the board of directors held soon after the close of its 1941 National Machine & Tool Progress Exhibition, the American Society of Tool Engineers named the following officers for the coming year:

Frank W. Curtis, Van Norman Machine Co., Springfield, Mass., president; Otto W. Winter, Columbus McKinnon Chain Corp., Tonawanda, N. Y., 1st vice-president; Ray H. Morris, Hardinge Brothers, Hartford, Conn., 2nd vice-president; Clyde L. Hause, Gorham Tool Co., Detroit, secretary, and Frank R. Crone, Lincoln Motor Co., Detroit, treasurer. Ford R. Lamb continues as executive secretary of the A.S.T.E.

Pontiac to Build Ordnance Materiel for U. S. Navy

Four Other General Motors Divisions Concentrate on Browning Machine Guns; Ford Shut-Down Interrupts Defense Projects

Pontiac Motor Division became the sixth General Motors automobile manufacturing unit to engage in the national defense program when an agreement was reached with the Navy Department for plant expansion totaling $5,700,000 for the manufacture of naval ordnance materiel. The plant expansion will get under way soon at Pontiac, Mich.

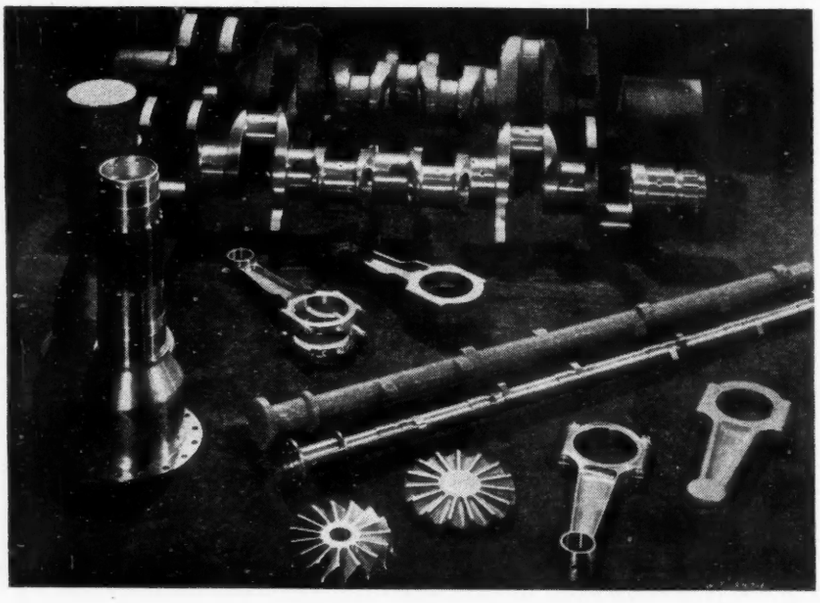
Of the other GM automobile divisions, Chevrolet and GM Truck are producing army trucks, Buick is building an airplane engine factory at Melrose Park, Ill., Oldsmobile's forge plant will turn out 75 and 105-mm. shells starting in May and Cadillac is making more than 30 parts for the Allison aircraft engine.

Robert H. Ahlers, general plant manager for the past four years, has been placed in charge of defense work for Pontiac. Buell Starr, assistant superintendent of the motor plant, will be defense plant superintendent; Robert Blackinton, chief tool engineer, becomes master mechanic; Stanley Baughman will be standards engineer, and Fred Maltbie will head the defense design department. Other new appointments in the defense division are Paul Gaugh, inspection; W. L. Kelly, night superintendent; Stanley Dotson, material supervision; Leonard J. Redford, purchases; Ivan J. Long, personnel, and W. T. Jones, comptroller.

Pontiac is the second motor car manufacturer to aid in the Navy's expansion program, Hudson Motor Car Co. having already started work on a $20,000,000 naval ordnance plant just northeast of Detroit.

First of the 20,000 machine guns which Saginaw Steering Gear Division of General Motors is scheduled to produce was tried out March 27 by Gov. Murray D. VanWagoner, of Michigan, in a demonstration on the plant range at Saginaw. The weapon, a .30-caliber air-cooled Browning gun, can fire 600 bullets per min. Alvah B. Phelps, general manager of the division, said it was the first such gun to be made by production tools outside the small arms industry. This gun shoots 100 more bullets per min. than the army specifications required.

The new building, 360 by 660 ft., housing the machine gun manufacturing operations will be dedicated April 23. A production rate of 100 guns per day is expected some time during the summer. The Browning .30-caliber machine guns cost $667.53 apiece and total 265 parts. Each part requires an average of 30 machine operations, the gun bolt alone requiring 123. The .50-caliber gun has 285 parts.



Cadillac-Allison Parts

Finished parts made by Cadillac for Allison aircraft engines provide sharp weight contrasts with the original forgings. The finished crankshaft weighs 103 lb. but the forging weighed 274 lb. The propeller shaft (left) weighs 24 lb.; its forging, 88 lb. The camshaft lost 75 per cent of its weight in processing and the finished supercharger vane (in foreground) was reduced from seven pounds to eight ounces.

Saginaw Steering Gear is one of four GM divisions that will share a $61,398,872 order for 71,225 Browning machine guns for the U. S. Army. Other divisions engaged in the work are AC Spark Plug at Flint, Frigidaire at Dayton, Ohio, and Guide Lamp (Brown-Lipe-Chapin) at Syracuse. Five types will be made in all, two .30-caliber and three .50-caliber. The number and cost of each type are .30-caliber A4 flexible, 20,004 @ $667.53; .30-caliber M-2 fixed aircraft, 9097 @ $641.71; .50-caliber M-2 fixed aircraft, 19,998 @ $1,006.29; .50-caliber M-2 flexible aircraft, 14,741 @ $1,006.29, and .50-caliber, heavy-barreled type, 7385 @ $1,094.35.

GM Diesels for Navy

Contracts aggregating $40,815,000 with the Cleveland Diesel Engine Division of General Motors, were announced by the Navy Department on April 8, all but $12,324,000 being for propelling machinery. The contracts specify: propelling machinery for 18 submarine chasers, $7,650,000; propelling machinery for 70 motor mine sweepers, $8,441,000; propelling machinery for 20 mine sweepers, $12,100,000; 158 sets of diesel-engine-driven generators for 50 coastal mine sweepers, 90 motor mine sweepers and 18 mine sweepers.

The strike of the UAW-CIO at the Ford Motor Co. River Rouge plant has delayed completion of the aircraft engine factory which is scheduled to begin turning out 2000-hp. Pratt & Whitney Double Wasp engines in June. The building is virtually completed except for interior finishing. The strike also has stopped production of the ¼-ton reconnaissance cars (blitz buggies), of which 714 of the 1500 ordered by the U. S. Army have been completed. However, deliveries were five weeks ahead of schedule.

Ford recently received a government order for $1,417,000 for 1786 1½-ton trucks for the CCC. The contract provision requiring compliance with labor laws was not included, such as the one which prompted Ford to withdraw its low bid on 11,528 trucks for the army.

Recent national defense orders to automotive companies included $1,400,852 to International Harvester Co. for 2½-ton trucks; $1,373,171 to Studebaker Corp. for 2½-ton trucks; $576,575 to Chevrolet for ½-ton and 1½-ton trucks and ambulances; $631,665 to Fargo Motor Corp., Chrysler subsidiary, for ½-ton trucks and five-passenger sedans for the army; $481,244 to Lavine Gear Co., Milwaukee, for 1-ton trailers

Cimatool-Sheffield Merger

The Cimatool Co. and the Sheffield Gage Corp., both of Dayton, Ohio, have announced the merger of the two affiliated companies into a single company to be known as the Sheffield Corp. O. O. Poock is chairman of the board; Louis Poock is president and general manager, and C. H. Reynolds is vice-president.

$200,000,000 for Plant Contracts in Chicago Area

Industrial plant expansions to meet national defense requirements in the Chicago area were increased since early in March by more than $200,000,000, including $120,000,000 allocated by Commonwealth Edison for a three-year program to provide 466,000 kilowatts of additional power for the defense emergency, and $14,000,000 by Revere Copper & Brass for a new Chicago plant, authorized by defense officials, which constitutes a hike from the original $9,000,000 figure reported several weeks ago. This is in addition to $16,000,000 authorized for a Cleveland plant.

Another $5,000,000 for new plant and equipment facilities were reported by American Steel Foundries, Foote Bros. Gear & Machine Corp., Danly Machine Specialties Co., Independent Pneumatic Tool Co., United Drill & Tool Corp., Illinois Tool Works, Clearing Machine Corp., and Miehle Printing Press Mfg. Co. Of this total $3,000,000 initiates with the companies not producing military goods, and $2,000,000 is for companies for which certificates of necessity were issued by OPM for production of defense orders.

General Electric X-ray Corp. will erect a five-story addition to its manufacturing plant at a cost of $500,000 to handle sub-contracts for defense orders for production of its recently developed 1,000,000-volt industrial X-ray apparatus used by the army and navy for testing steel used in armaments.

Acme Industrial Co., maker of machine tool equipment, will spend $75,000 for a 150 x 150 ft. floor addition to present plant facilities, and $100,000 for new machinery.

40 YEARS AGO

A Letter to the Editor

Sirs:

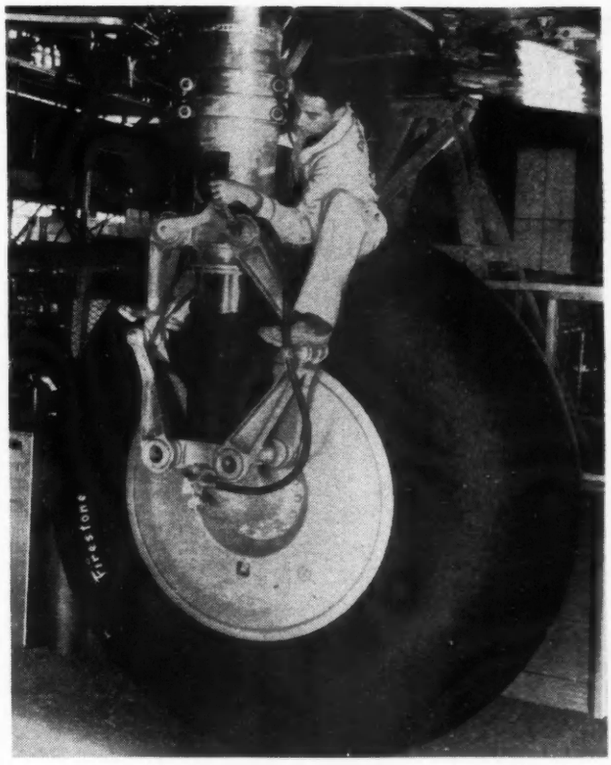
I have noticed with great interest the accounts of "endurance tests" for automobiles, and especially the particulars of the coming Long Island Run. What real good do such contests do so far as we users are concerned? Like a horse, an automobile can be fixed up to make a long run, and then go to pieces at the end. In my mind, a real test would be to run carriages, say 25 miles a day for a week, and then let the condition of the machinery and running gear be taken into consideration when awarding the prizes. A carriage should certainly be able to go six days without visiting the machine shop if it is cleaned and oiled properly and loose bolts and screws set up as discovered. Such an experience would be about what the ordinary purchaser of a carriage will give his vehicle.

(Signed) R. D.

From the *Horseless Age*, April, 1901.

41-Ton Bump!

Although the 82-ton Douglas B-19 bomber has a tricycle landing gear each of the giant eight-foot tires is built to withstand half the total load. Each tire weighs 961 lb., contains 148 miles of cotton cord and three miles of bead wire.



Passenger Car and Truck Production

(U. S. and Canada)

	February 1941	January 1941	February 1940	TWO MONTHS 1941	TWO MONTHS 1940	TWO MONTHS Per Cent Change
Passenger Cars—U. S. and Canada:						
Domestic Market—U. S.	385,676	401,799	324,555	787,475	673,310	+17.0
Foreign Market—U. S.	8,807	9,459	13,201	18,266	27,343	−33.1
Canada	10,647	11,990	12,779	22,637	25,358	−10.6
Total	405,130	423,248	350,535	828,378	726,011	+14.0
Trucks—U. S. and Canada:						
Domestic Market—U. S.	78,580	77,682	53,960	156,262	109,006	+43.2
Foreign Market—U. S.	12,460	11,991	12,316	24,451	26,652	− 8.3
Canada	13,063	11,205	5,414	24,268	10,048	+142.6
Total	104,103	100,878	71,690	204,981	145,706	+40.6
Total—Domestic Market—U. S.	464,256	479,481	378,515	943,737	782,316	+20.6
Total—Foreign Market—U. S.	21,267	21,450	25,517	42,717	53,995	−21.0
Total—Canada	23,710	23,195	18,193	46,905	35,406	+32.3
Total—Cars and Trucks—U. S. and Canada	509,233	524,126	422,225	1,033,359	871,717	+18.5

Monthly Motor Vehicle Production

(U. S. and Canada)

	PASSENGER CARS 1941	PASSENGER CARS 1940	TRUCKS 1941	TRUCKS 1940	TOTAL MOTOR VEHICLES 1941	TOTAL MOTOR VEHICLES 1940
January	423,248	375,476	100,878	74,016	524,126	449,492
February	405,130	350,535	104,103	71,690	509,233	422,225
Two Months	828,378	726,011	204,981	145,706	1,033,359	871,717
March	.....	364,947	.....	75,285	.....	440,232
April	.....	375,628	.....	76,807	.....	452,433
May	.....	338,353	.....	74,139	.....	412,492
June	.....	294,779	.....	67,787	.....	362,566
July	.....	172,166	.....	74,005	.....	246,171
August	.....	48,333	.....	41,533	.....	89,866
September	.....	227,880	.....	56,703	.....	284,583
October	.....	428,270	.....	86,104	.....	514,374
November	.....	417,905	.....	93,068	.....	510,973
December	.....	408,184	.....	98,747	.....	506,931
Total	.....	3,802,454	.....	889,884	.....	4,692,338

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

Continuing expansion of business activity is evident. The seasonally adjusted index of The New York *Times* for the week ended March 29 rose to 124.1 per cent of the estimated normal, an all-time peak, as against 122.3 for the preceding week and 98.9 a year ago. The unadjusted index of *The Journal of Commerce* for the same period also established a new record—121.3 per cent of the 1927-29 average, as compared with 120.2 for the week before.

Department store sales during the week ended March 29, according to the Federal Reserve tabulation, exceeded by 34 per cent the total for the corresponding week last year, a post-Easter period. For the four-week period ended on that date, the gain over comparable 1940 sales was 9 per cent.

Bank debits to deposit accounts, except inter-bank accounts in leading cities during the thirteen-week period ended April 2 were 15 per cent above the total a year earlier.

The movement of railway freight registered a contra-seasonal increase in the week ended March 29. Loadings totaled 792,125 cars, 3.1 per cent more than for the week before and 25.9 per cent more than the comparable number last year.

Electric power production during the same week declined less than seasonally to a level 15.7 per cent above that a year ago; the similar gain for the preceding week was 15.9 per cent.

Business failures during the week ended April 3 dropped to 267 from 302 for the week before, according to the Dun & Bradstreet report, as against 274 a year ago.

Crude oil production in the week ended March 29 averaged 3,746,550 barrels daily, 65,500 barrels above the average for the preceding week and 91,050 barrels more than the currently required output as computed by the Bureau of Mines.

Average daily output of bituminous coal during the same period was 1,967,000 tons, as compared with 1,900,000 tons a week earlier and 1,412,000 tons a year ago.

Engineering construction contracts awarded in the week ended April 3 totaled $68,989,000, or 24 per cent more than the corresponding amount last year, according to *Engineering News-Record*. The total last month was $452,130,000, as against $179,836,000 in March, 1940.

Professor Fisher's index of wholesale commodity prices for the week ended April 4 rose to 88.7 per cent of the 1926 average, a new peak for this year; the figure for the preceding week was 88.3.

Member bank reserve balances decreased $127,000,000 during the week ended April 2, and estimated excess reserves declined $70,000,000 to a total of $5,940,000,000. Business loans of the reporting members increased $45,000,000 and stood at $5,465,000,000, exceeding by $1,051,000,000 the comparable total last year.

Labor Negotiations Provide Cue for Future Steel Prices

Mills Continue at Better than 99 Per Cent Despite Ford Strike and Slack in British Demand for Carbon Steels

By W. C. Hirsch

Aware that the price they will have to pay for steel depends largely on the outcome of the negotiations pending between the leading producer and the C.I.O. union, consumers showed little concern because of Washington reports that "officials would view with displeasure any general advance in steel prices at this time." Obviously there is a limit to wage concessions that steel producers can grant without having recourse to price increases, but in view of the Government's vital interest in a solution of the problem without adding to the national defense cost, consumers feel rather hopeful.

Although base prices are unchanged from what they were before the national emergency period, the cost of extras has generally moved upward, and some of the smaller steel mills have been able to sweeten profits by having buyers consent to billings on an f.o.b. mill basis in place of f.o.b. basing point or delivered. A sharp increase in business going to warehouse men and other resellers reflects the urgent need of many consumers, who prefer paying a higher price to waiting for this or that mill to be in a position to accommodate them with whatever tonnage they need immediately.

Temporary suspension of orders for carbon steel for England at the behest of the British Iron and Steel Federation has not relieved pressure on mill capacity to any great extent. The suspension does not apply to alloy steels. More and more demand is noted for alloy plates, and steady progress is being made in diverting the capacity of sheet and strip mills to the rolling of light plate, needed in defense equipment.

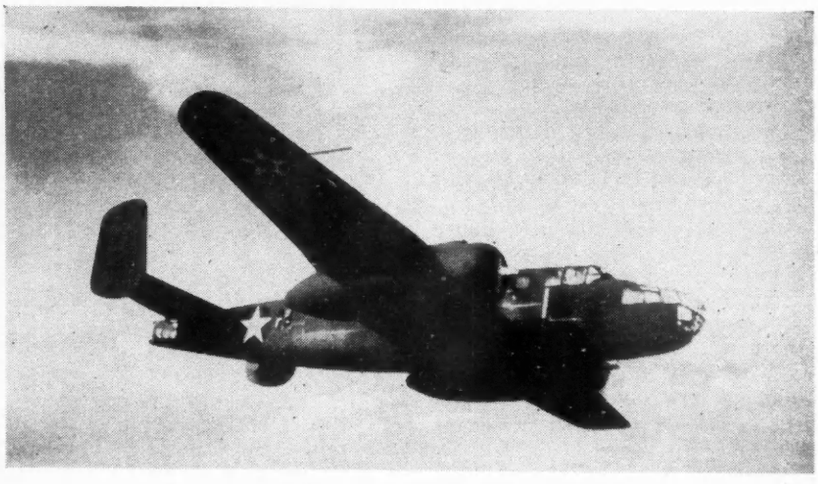
Operations of the steel industry were not affected by the Ford strike; in the week that followed that development, 99.3 per cent of the country's ingot capacity was employed, according to the American Iron & Steel Institute, compared with 99.2 per cent in the preceding week.

The supply of copper was helped to the extent of 25,000 tons when the Metals Reserve Co. took over that tonnage from interests that held it for the French government. The Price Stabilization Division of the National Defense Council has let it be known that sales at higher levels than 12 cents a pound, the quotation of producers for some time, are not justified. This means that custom smelters, who heretofore have done quite a business at slightly higher prices, will have to lower their quotation to conform with the permissible maximum price.

Tin importers are puzzled as to what is behind the purchase of a round tonnage by the Navy Department at a higher price than it could have obtained the metal from the Metals Reserve Co. Spot Straits tin is quoted in the open market at 51¾ to 52 cents.

A maximum price of 5.85 cents a pound, New York, has been set for lead by the National Defense Council. This move freezes the prevailing price of lead.

The paucity in the supply of nickel is reported by stainless steel makers to have eased somewhat.



Acme

Bomber in War Dress

A North American B-25 twin-engine medium bomber painted in the dull war-time hue of the U. S. Army Air Corps.

MEN . . . . . .

Rearrangement of management personnel at the Douglas Aircraft Co., Santa Monica, Cal., includes the promotion of **Carl A. Cover** to the post of executive vice-president; **George A. Strompl** to director of inspection standards for all plants, and **H. D. Houghton** to manager of the Long Beach operations.

W. K. Ebel formerly chief engineer of the Glenn L. Martin Co., Baltimore, has been promoted to the post of vice-president in charge of engineering and has been named a director of the company. He also retains his title and activities as chief test pilot.

Robert L. Clause has been elected president of the Pittsburgh Plate Glass Co., succeeding **H. S. Wherrett** who becomes vice-chairman of the board.

R. H. Daisley, vice-president in charge of the Wilcox-Rich Division of Eaton Mfg. Co., Cleveland, has been elected to the board of directors. **Daniel Dewey, Charles C. Bradford, George W. Veale** and **Joseph L. Dostal** have been appointed vice-presidents.

All officers and directors of Thompson Products, Inc., Cleveland, Ohio, have been reelected. In addition **W. M. Albaugh,** former treasurer was elected vice-president in charge of replacement divisions and **J. D. Wright,** former secretary, was elected secretary-treasurer. Mr. Wright continues as manager of the recently organized subsidiary, Thompson Aircraft Products, Inc.

Thomas J. Kiely has been named sales manager of the Aviation Division of the American Bosch Corp., Springfield, Mass.

Donald H. Spicer is the new general manager of the World Bestos Corp., Paterson, N. J.

James M. White has been appointed assistant general works manager of Allis-Chalmers Mfg. Co.

Harold R. Boyer, on leave of absence from the presidency of Allen Industries, Inc., Detroit, has been appointed chief of the manufacturing unit, aircraft section, of OPM, succeeding **Arthur J. Brandt,** of Detroit, resigned.

Forest S. Baster has been named vice-president in charge of engineering of White Motor Co. **Robert Cass,** former assistant, will succeed Baster as chief engineer, while **O. F. Quartullo** becomes chief engineer of the White Horse Division.

William W. Britton, has been named special representative for the Pacific Coast territory of Jessop Steel Co., Washington, Pa. His headquarters will be in Los Angeles.

Laminated Shim Co., Inc., Glenbrook, Conn., has announced the appointments of **E. B. Nisbet,** as executive vice-president; **E. R. Young,** as vice-president in charge of production, and **Richard Seipt** as vice-president in charge of sales.

New P & W Assembly Line

Pratt & Whitney's new "green" assembly line handles double-row engines on the left, single row engines on the right. Appropriate sub-assemblies feed in from both sides.

E. E. Richards has joined the Studebaker Corp. as assistant to the president.

National Battery Co., St. Paul, Minn., announces the appointment of **H. G. Barnes** as vice-president and general manager in charge of its Gould Commercial Division, Depew, N. Y.

James P. Gillies has joined the general sales staff of Chicago Pneumatic Tool Co., New York.

The Lincoln Electric Co., Cleveland, O., announces the appointment of **B. J. Brugge** as its welding consultant and engineer at Washington, D. C. He will be associated with T. A. Canty, Inc., Lincoln representatives at Baltimore.

Spencer Phenix has been elected a director of the American Bosch Corp.

R. S. Marthens, former manager of the Westinghouse Gearing Division, has been appointed staff assistant to the manager of the Canton Ordnance Division of the Westinghouse Electric & Mfg. Co.

Langbourne M. Williams, Jr., president of Freeport Sulphur Co. and Cuban-American Manganese Corp., has been elected a director of National Aviation Corp.

Don I. Carroll, vice-president in charge of production, and **Rudolph Teetjeb,** of Emanuel & Co., have been elected directors of Vultee Aircraft, Inc., with expansion of the board of directors from seven to nine men.

James Braden, member of the general sales staff of Chevrolet, has been appointed Chevrolet publicity director for Campbell-Ewald Co., succeeding **N. W. Hopkins,** on special assignment.

Buick has announced the following changes in its engineering personnel: **E. E. Hartz** to chief of engine test for the new airplane engine plant, **F. L. McNamara** to head of the aircraft engine specifications and engineering accounts, **Lee Poole** to head of the automobile specifications division and **C. A. McKinney** to head of the automobile dynamometer division.

R. L. Hamilton has been elected vice-president of the Dumore Company, Racine, Wis., with which firm he has been connected since his graduation from Notre Dame University in 1934.

W. Alexander McCune, Jr., has been appointed field engineer in the Philadelphia territory for the Abrasive Division of Norton Co., Worcester, Mass.

H. N. Nickerson has been made works manager of the Detroit plants of Evans Products Co.

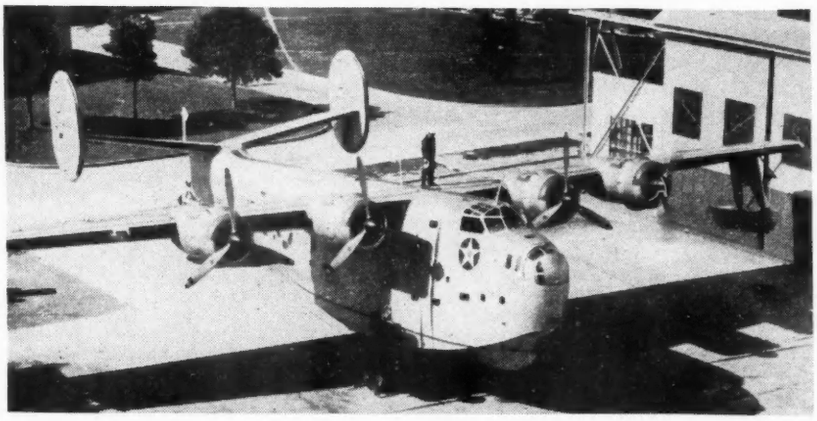
Harry L. Strube is the new chief engineer of eastern division of Link Belt Co. with headquarters in Philadelphia. He replaces **F. F. Waechter,** resigned.

H. A. H. Pray has been named head of a new division of electrochemical research at Battelle Memorial Institute, Columbus, Ohio.

J. Stirling Getchell, Inc., New York, advertising agency, has announced election of **John V. Tarleton** as president and **Paul Hollister** as vice-president.

C. J. Huebner has been elected vice-president and **E. E. Fowler** assistant treasurer of Muskegon Motor Specialties Co.

John Pathe has been promoted to the office of chief inspector, Plymouth Division, Chrysler Corp.



Acme

Navy's Current Biggest

Consolidated's brand new PB2Y2 Bomber is billed as the Navy's biggest. With a wing span of 115 ft., it is said to carry huge bomb loads and has a cruising range of approximately 5000 miles.

BOOKS . . . .

BOOK OF STANDARDS SUPPLEMENT. *Published by the American Society for Testing Materials, Philadelphia.*

To keep up to date its triennially-published Book of Standards, the American Society for Testing Materials in the two intervening years issues supplements to each part of the book. The 1940 supplement, recently issued in three parts, gives in its latest approved form 292 specifications, tests and definitions which were either issued for the first time in 1940, or revised. Part I covers Metals; Part II, Non-Metallic Materials Used for Construction Purposes, and Part III, Coal and Coke, Petroleum Products and Lubricants, Electric Insulating Materials, Plastics, Rubber Products, Textile Materials, Paper, etc.

TANKS AND OTHER MILITARY TRACK-LAYING VEHICLES, *bibliography by Douglas W. Bryant, Detroit Public Library. Published by Library of Congress, Washington, D. C.*

A cooperative undertaking to compile and publish bibliographies on technical subjects of interest in connection with National Defense has been initiated by the Library of Congress. The first such bibliography to make its appearance covers "Tanks and Other Military Track-Laying Vehicles" and was compiled by Douglas W. Bryant, senior library assistant, technology department, Detroit Public Library. It is intended chiefly for the use of those interested in the design and production of tanks and other military track-laying vehicles. Material on the use of such vehicles and on their tactics in battle has not been included. The references are classified under the following headings: General, History, Models and Designs (1915-1920, 1920-1930, 1930-1940), Design, Manufacture and Testing, Engines, Track Mechanisms, Armor Plate and Hulls, Detail Elements and Accessories, and Bibliographies.

HANDBOOK OF WELDED TUBING, *Formed Steel Tube Institute, 1621 Euclid Ave., Cleveland, Ohio.*—The object of this handbook is to furnish designing engineers with information regarding standard sizes and properties of welded tubing. Standard sizes, together with commercial tolerances for roundness, wall thickness, straightness, etc., are tabulated for various grades of welded tubes. The manufacturing and fabricating processes are illustrated, and dimensioned drawings show on typical examples to what degree welded tubing can be cold-worked in such operations as bending, beading, flanging, expanding, tapering, etc. Special attention is given to recommendations for laying out fabricated parts and methods of checking. The reader is further provided with suggestions which will aid in developing designs for the most economical use of tubular sections. The handbook is of pocket size, in a loose-leaf binding.

A. S. T. M. Appoints Electroplating Committee

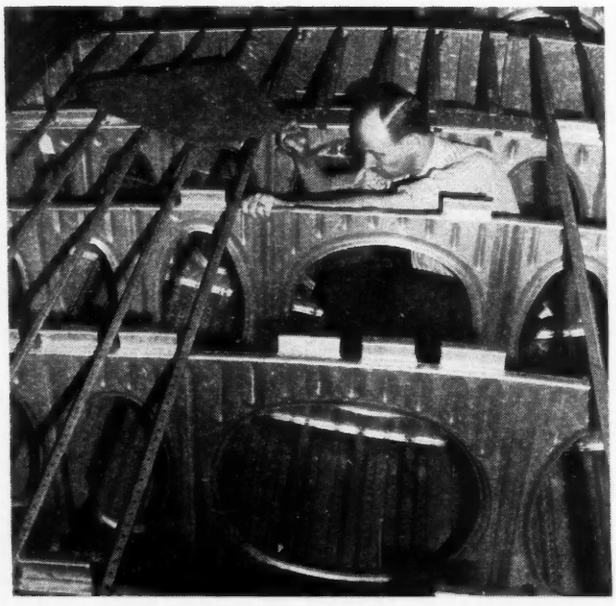
With the organization by the American Society for Testing Materials of the new Committee B-8 on Electrodeposited Metallic Coatings, effected during A.S.T.M. Committee Week in Washington in March, plans for the realignment of the society's work on electroplating have been put into effect. The new committee is to concern itself with the formulation of specifications and methods of tests for electrodeposited metallic coatings, with the exception of zinc and cadmium on steel.

E. M. Baker, professor of chemical engineering at the University of Michigan, was appointed chairman; E. A. Anderson of the New Jersey Zinc Co., vice-chairman, and Gustaf Soderberg, technical director, The Udylite Corp., secretary.

The committee plans to submit at the A.S.T.M. annual meeting in June new specifications covering electrodeposited copper - nickel - chromium coatings on zinc and zinc-base alloys, and electrodeposited nickel-chromium coatings on copper and copper-base alloys.

Frank Gause

Frank Gause, secretary of The Four Wheel Drive Auto Co., Clintonville, Wis., died April 2, of a cerebral hemorrhage. Mr. Gause was 71 years old and had been secretary of the corporation since its inception in 1910.



Wing Scrutiny

Noting design details as he works his way through a skeleton wing, this Ford expert substantiates the report that Ford engineers are "wrapped up" in preparations for mass production of sub-assemblies for four-engined Consolidated B24D Bombers.

PUBLICATIONS

A new 24-page List Price Catalog, with Interchange Charts, gives reference data on the complete Ahlberg Bearing Company's line of **ball, roller, and thrust bearings** for automotive replacement.*

The Budd Wheel Co. new 1941 catalog on **Budd Duals** contains information useful to engineers in the selection of new equipment and the use of correct tire and wheel combinations.*

"How Research Can Save Dollars for You" is a new well-illustrated booklet, by the General Box Co. It points out how packaging research can save valuable man-hours for the shipper. The advantages of the **General All-Bound box** are told in story and picture.*

American Iron and Steel Institute has just released a booklet **"Answers to Questions about Steel in Defense."***

In the March issue of Executives Service Bulletin, published by the Policyholders Service Bureau, Metropolitan Life Insurance Company, are four articles on **today's personnel problems.***

The DeVilbiss Co. has a new catalog on its **air compressing equipment** with illustrations and descriptions of 65 air compressing outfits and complete specifications for each unit.*

The Formed Steel Tube Institute, 11 W. 42nd St., New York City, has a new **Handbook of Welded Steel Tubing.** The book is priced at $1.00.

Paint Progress, Vol. 2, No. 2, by New Jersey Zinc Co., presents seven articles covering both **interior and exterior, wood and metal painting.***

Socony-Vacuum has revised its Engineering Bulletin (Series 71) on the lubrication and maintenance of General Motors Diesel Engines.*

Chicago Rivet & Machine Co. has just released its new booklet describing, illustrating and giving specifications of four of its **riveting machines for aircraft production.***

National Broach & Machine Co.'s booklet, "Red Ring Shaved Gears", contains comprehensive information on **heavy-duty, ultra-precision gear finishers.***

A new spiral-bound brochure, just published by Continental Machines, Inc., is directed especially to trade and vocational schools and contains much information useful for training.*

Shewin-Wiliams Co. has a new **Plant Maintenance Painting Guide,** with specifications for proper maintenance presented in graphic chart form.*

Norton Co. has two new booklets: **Grinding and Finishing With Portable Equipment,** illustrated and containing specifications of types and sizes of grinding wheels commonly used on portable grinders; and **Disc Grinding** which includes a table of recommendations to cover the more common applications of disc wheels and plate mounted cylinders.*

Gas Cutting Machines for Marine Construction, a new 26-page booklet issued by Air Reduction, has been published to make available convenient descriptions of the various newly-developed machines for aiding fabrication by welding in the marine industry.*

Koebel Diamond Tool Co. has just published an interesting booklet "Meet Joe Green, Grinder Hand" which points out to manufacturers their responsibility for training men in the use of small tools. A smaller booklet, "For Grinder Men Only," is enclosed. This presents in a unique manner the most important instructions for the use of diamond wheel dressing tools.*

* Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE INDUSTRIES, M. W. Bourdon.

A 24-hour census taken in January at 42 points in the London area showed that the ratio of civilian to military vehicles was 25 to 1. During the same month there were 2929 casualties from road accidents and in 219 of these accidents military vehicles were involved, a ratio of 13 to 1.

* * *

Owing to the ban upon the sale of new vehicles, except by special permit of the Ministry of Transport, only 197 passenger cars and 453 trucks of all sizes were registered for the first time in January, the last month for which returns have yet been issued. The number of cars compares with 5657 in the same month of last year and 27,326 in Jan., 1939.

* * *

From May 3 to August 9 this year an extra hour will be added to "summer time" schedule, making two hours advance on Greenwich mean time. This will result in lighting-up time for vehicles at midsummer being 11.20 P.M. instead of 10.20 P.M. last year and 9.20 P.M. before "summer time" hours were introduced.

* * *

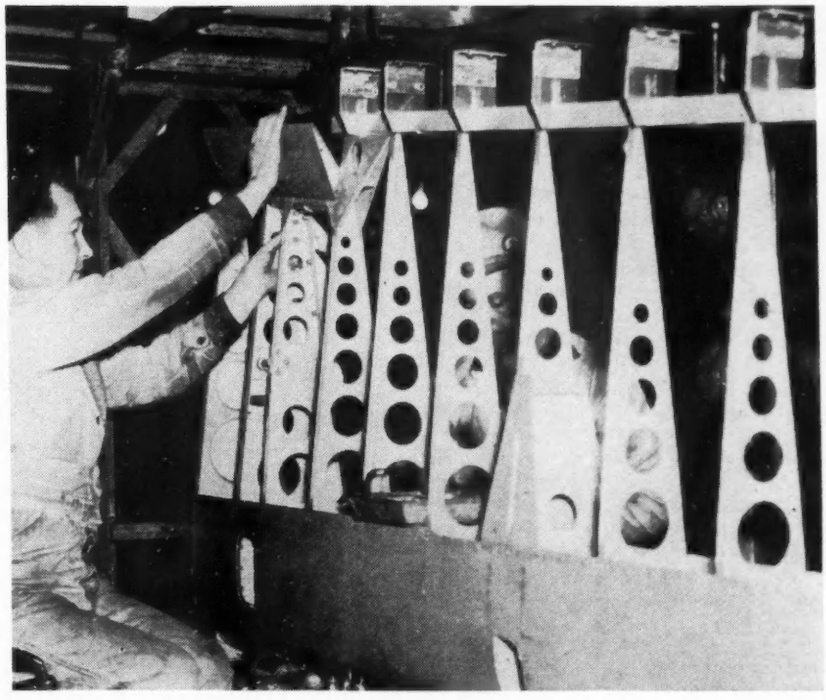
Plans for the provision of more adequate road transport facilities for areas having suffered intensive air attack have been drawn up and submitted to local authorities. Transport pools are already in operation in many localities, consisting of vehicles suitable for debris cleaning, furniture removal, food transport and the conveyance of water containers.

* * *

Long-distance truck drivers compelled to drive for many hours at night with the greatly restricted lights enforced by the blackout regulations complain that night vision under such conditions gradually deteriorates almost to vanishing point after two hours or so at the wheel and that before the usual six-hour spell has been completed, their eyes have ceased to function with even moderate efficiency.

* * *

Thomas Tilling & Co., the parent company of many large bus operating concerns in the English provinces, reports that such promising results have been obtained from producer gas used experimentally under service conditions that it has decided as a further experiment to operate all the units of one of its fleets on this fuel.



Goodyear Parts for Martin

Sub-assemblies for Martin military aircraft are currently in production at Goodyear Tire & Rubber Co. plants. Drawing on its experience in light metal craft for airships, Goodyear has several hundred men at work on such jobs as this control surface assembly.

Truck Production by Capacities

(U. S. and Canada)

	TWO MONTHS				
	Units			Per Cent of Total	
	1941	1940	Per Cent Change	1941	1940
1½ Tons and less	177,776	129,594	+37.1	86.74	88.93
2 to 3 Tons	19,257	9,761	+97.0	9.39	6.70
3½ Tons and over	3,165	1,904	+66.0	1.54	1.31
Special and buses	1,617	988	+63.8	.79	.68
Station Wagons	3,166	3,469	− 8.8	1.54	2.38
Total	204,981	145,706	+40.6	100.00	100.00

MEN and MACHINES

(*Continued from page* 438)

sures up to 50 lb.

FISLER ENGINEERING Co., Newark, N. J., has placed on the market the multiple spot welder illustrated herewith. Adjustments can be made to make circular, straight, square, rectangular or odd-shape welds, to conform to any need. From two to 12 spots can be made simultaneously, depending on the nature of the job. These machines are intended primarily for the spot welding of light sheet metal work where large range of adjustments for various spots and shapes are to be considered.

Pressure electrodes are used, with suitable air-operation equipment. The electrodes have individual adjustment, to make it possible to maintain an even pressure on all the spot welds being made.

THE PRATT & WHITNEY standard measuring machine, the latest model of which has just been announced, consists of a master bar, a dividing screw, and a means of controlling measuring pressure, all mounted on a rigid bed. The master bar is graduated at each inch interval, to provide a permanently-accurate setting. The graduations are extremely fine hair lines, visible only through a microscope. The measuring head includes a microscope, with two hair-line graduations used when setting to match the hair line on the master bar, and a precision dividing screw which subdivides one inch. The measuring pres-

sure is controlled by the Electrolimit pressure tail stock. The Standard measuring machine is claimed to be a practical means of duplicating measurements to one-one hundred thousandths of an inch.

THIS instrument is designed for the accurate measurement of a wide range of internal dimensions. It is said to be quick and accurate, and to indicate out-of-round, taper and bell-mouth conditions. It is particularly suited for checking ring gages and similar parts. By taking ordinary precautions with respect to cleanliness, temperature and operating technique, this comparator may be read with an accuracy of 0.00002 in. It covers a range of sizes of from ½ to 10 in. diameter inclusive, and requires a floor space of 18 by 20 in. plus a circle of 13⅛-in. diameter for the indicator stand. It operates from any 110-115 volt 60-cycle a.c. source having reasonably constant voltage and frequency regulation.

How the Locking-Tool Clamps the Punch-Lok band on a hose joint.

PUNCH-LOK CO., Chicago, has placed on the market a mechanical device bearing its name, for clamping hose to various kinds of fittings, special nipples, menders and ordinary pipe. The Punch-Lok method is applied by double-wrapping a broad, galvanized steel band of high strength around the joint and after tensioning the band with a pull of 1000 lbs. within the special Loking-Tool, the ends are securely locked together within a flat steel clip and the excess band is cut off flush with the clip. Parts of the Loking-Tool are made from drop-forged, heat-treated tool steel and are cadmium-plated to prevent corrosion.

A TOCCO JUNIOR machine of 20 KW (output) capacity has been developed by the Ohio Crankshaft Company of Clevelard, for use in plants whose size does not warrant the installation of elaborate heat-treating equipment.

It is offered in two models, one for applications not requiring quenching, such as annealing, brazing, soldering,

Tocco Junior hardening machine.

and heating for forming and forging; the other for localized TOCCO-hardening. In the hardening machine a transformer housing and work pan have been added to the otherwise flat-topped basic 20 KW unit. The rotatable transformer panel, to which the inductor block is attached, is similar to that of the larger TOCCO Junior units, as are the quench and cooling water valves, condensers, tapped bosses for holding fixtures in alignment with inductor, and other well-known TOCCO features.

Both of the 20 KW Junior models use the same high frequency motor-generator sets, supplying 9600-cycle alternating current at 220 volts, and both units have all required control devices. For TOCCO-hardening, the 20 KW is equipped with pre-set, full automatic controls and a suitable hardening fixture.

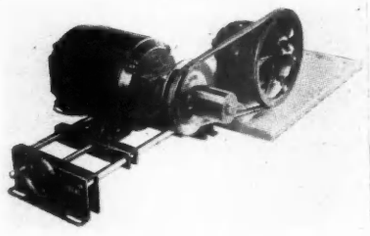
ADDITION of five new styles to its low-priced, mass-production line of standard tools is announced by Carboloy Co., Inc. Available in a total of 21 sizes, the new standard tools are all carried in stock and comprise four "offset" types and a two-way square-shank turning style. With the exception of the last-mentioned, each type is available in two grades, one for steel cutting and one for cast iron etc. In addition, a revision of Carboloy standard tool prices is also announced.

A NOVEL tool-control and standardization program, permitting the use of standard tools for most operations involving the use of tungsten carbide, has been evolved by Federal-Mogul Corporation. Standard Carboloy tools are used almost exclusively, such special tool shapes as are required being obtained by regrinding the standard tools to the shapes desired. Similarly, forming tools are built up from a combination of standard tools, a form of toolholder developed by Federal-Mogul being used. Prior to the formulation of this program, cemented carbide tools were largely special in character, and the cost involved in such specialized designs mitigated against their wider use in the plant. As a result, the majority of the tools were of high-speed steel.

A FULLY automatic machine for spray-coating the inside of projectiles is offered by the Eclipse Air Brush Co., Newark, N. J. The machine, which is illustrated, sprays the inside of 155 mm. shells at the rate of 500 an hour, although this same type machine can be built to handle any size projectile or other cylindrical object.

The shells are picked up by metal arms from the conveyor belt, carried along in a horizontal position on the machine to a point in front of an automatic spray gun fitted with an extension nozzle. A master switch trips the trigger on the gun as it starts to move forward, and a rotating device, with which the gun is synchronized, spins the shell to insure an even coating. As soon as the nozzle has withdrawn from the projectile, the shell moves along, making room for the next one. At the end of the machine the metal arms deposit the sprayed shell, still in a horizontal position, on another conveyor belt.

THE IDEAL COMMUTATOR DRESSER CO., Sycamore, Ill., announces a new variable-speed pulley designed for light, inexpensive machinery. The pulley mounts directly on the motor shaft and requires only standard V belts. Among



Ideal variable-speed motor pulley.

the features of the pulley are short overhang, forced lubrication, a balanced sheaf, and all-metal construction. Both halves of the sheaf are movable axially, which is claimed to insure accurate belt alignment. The pulley faces are curved so that the belt has full contact at all pitch diameters. Speed ratios up to 2¾ to 1 available; sizes up to ¾ h.p.

The complete unit includes the "variable-pitch" pulley and the adjustable sliding motor base. By turning the handwheel of the base, the motor moves backward or forward, causing an increase or decrease in belt tension. This causes the pulley to open and close, changing the pitch diameter and the driven speeds. Speed changes are made while the drive is in operation.

A MAN CAN STAND A PAIN BUT AN ITCH ALWAYS GETS HIM

There are quite a number of car buyers today who will insist on a different make the next time they turn in their car. A great many of these have had to contend with the failure of comparatively unimportant parts and accessories on the cars they are now driving—things that seem to be beneath the attention of your engineers. And, Mr. Car Manufacturer, there are a lot of them—control knobs coming off—windows that work down by themselves—defroster hose that won't stay connected—etc. The engineers do a fine job, but don't go far enough.

King-Seeley recognizes the danger of an itch, and is constantly on the alert to keep King-Seeley Telegages from aggravating the purchaser of your cars.

You realize that there can be a considerable difference in the voltage in the circuit supplying electrically operated dashboard gages. But Telegages are designed so that a variation as much as from 4 to 9 volts will have no detrimental effect on them. When you standardize on King-Seeley Telegages, your customers have this protection and just that much less provocation to criticize your car when they are driving it.

KING-SEELEY
ELECTRIC TELEGAGES
show fuel level, oil pressure and water temperature. Transmission is entirely by wire—no tubes.

KING-SEELEY CORPORATION
ANN ARBOR MICHIGAN
SUPPLIERS OF ORIGINAL AUTOMOTIVE EQUIPMENT SINCE 1922

KS TELEGAGE

METALS FOR AUTOMOBILES

(*Continued from page* 415)

tution of metals and other materials, the OPM has organized a conservation unit, which is in charge of Robert E. McConnell, engineer of mines and a former president and director of various research, investment and development companies. Working with the OPM also is the Advisory Committee on Metals and Minerals of the National Research Council, National Academy of Sciences, which has been enlarged to undertake a series of surveys. Dr. Zay Jeffries, of the General Electric Co., Cleveland, is chairman of the committee.

Conservation by cooperation is the keynote sounded thus far by the recently-formed OPM conservation unit. This policy envisions voluntary efforts by manufacturers, merchandisers and consumers to shift wherever possible from the use of scarce materials to those which are more plentiful. A request has been sent to the National Association of Waste Material Dealers, Inc., to form committees to suggest means of maintaining adequate supplies of materials in each branch of the industry that it represents. The OPM is looking to the automobile industry for strong and effective support.

Although it is too early to make specific recommendations, it is felt that the automobile industry may be able to make an over-all average saving of 50 per cent in the use of these materials. This does not mean that a 50 per cent saving can be made as to every critical material; in some instances possible conservation may be greater, in others less.

Because of the number of problems arising in the minerals and metals field, a ferrous minerals and alloys branch has been established by the OPM priorities division to handle problems concerning iron ore, iron and steel scrap, chromium, manganese, tungsten, vanadium, molybdenum, nickel and the ferro-alloys. The OPM minerals and metals group now has four branches, this new one supplementing one each for iron and steel, non-ferrous metals, and aluminum and magnesium. The tools and equipment group is expanded to two branches, one for machine tools and the other for general equipment.

Automobile manufacturers are following developments closely and at the same time are rushing engineering studies of metal substitutions. H. Herbert Hughes, formerly chief economist of the Mineral Production and Economic Division of the U. S. Bureau of Mines, has joined the Washington staff of the Automobile Manufacturers Association to make a thorough study of the materials supply and to analyze current developments for the manufacturers.

As yet no interruption has occurred in the flow of raw materials to interfere seriously with automobile production. But there is a strong indication that an acute situation is developing in the metals market and that automobile manufacturers soon will face two problems—the use of material substitutes and the curtailment of production. Many factors are involved, such as producers' present and future capacity, labor, prices, imports, stocks on hand and actual needs of consumers.

Too, the secondary metals market must be taken into account, as there is a big difference between the volume of raw materials required for fabrication and the actual weight of the finished product. For example, a report issued by the Institute of Scrap Iron & Steel, Inc., several years ago, showed that in the automobile industry the tonnage of scrap derived from the junking of old cars, plus the scrap that is a by-product of the manufacturing operations of the industry, amounted to 80 per cent of the tonnage of new iron and steel required by the automobile industry.

One important aircraft engine manufacturer takes in about 6000 lb. of raw materials of various kinds to produce a finished engine weighing less than 1400 lb. Billets for forgings required for automobile and aircraft engine parts may weigh considerably more than the finished part. The excess—in chips, and turnings, in flash, in sheet steel scrap—is available for remelting and reworking into new steel and iron. One parts maker produces his entire output of electric furnace steel castings without drawing on virgin metal. All of the charge comes from the turnings and chips and sheet metal scrap from his own machine shops.

It is obvious that metals vital to passenger cars and trucks are just as vital to armament and mechanized equipment for war purposes, in some cases more so. The substitution of one metal for another may be satisfactory as to its physical properties, but unless the former is available in sufficient quantities, the substitution would not be feasible, especially if it involved changes in design and in factory tools and equipment. If a substitute material is used, its available supply may be the limiting factor in scheduling production.

The OPM has established a priorities critical list containing over 200 primary military items that are being assigned preference ratings automatically in orders by contracting officers of the Army and Navy. This list is subject to revision each month and at present includes the following metals, all of which were added recently except aluminum and brass:

Aluminum and aluminum alloys, pig or fabricated.
Brass, pig or fabricated.
Bronze, pig or fabricated.
Chromium alloy steel.
Electric furnace steel.
Magnesium and alloys, pig or fabricated.
Monel metal.
Nickel, pig or fabricated.
Nickel alloy steel.
Special treatment steel.
Tin.
Tungsten, ferro tungsten and tungsten ore.
Tungsten alloy steel.
Vanadium and vanadium alloys.
Zinc.

When shortages of items on the priorities critical list become so acute as to make necessary the control of their distribution, they are classified as mandatory priorities, as have been aluminum, magnesium, nickel, tungsten and 5 per cent of the zinc output, which places then under industry-wide control and allocation of them by the OPM priorities division takes precedence over preference ratings assigned them by the Army and Navy field staffs.

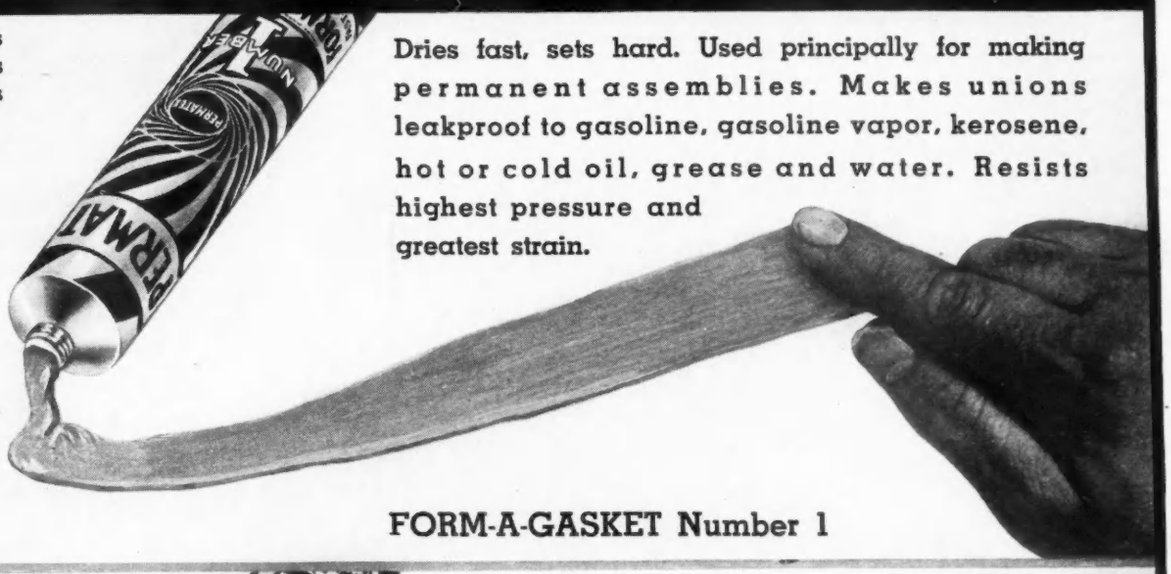
E. R. Stettinius, Jr., OPM director of priorities, has issued allocation orders on mandatory priority materials, including Neoprene, which is the only non-metallic material assigned so far to the mandatory priority class, although other synthetic rubbers also are included on the priorities critical list. In the April allocation of Neoprene, nearly 1,000,000 lb. of it will go to approximately 250 companies and industrial users for defense orders. E. I. du Pont de Nemours Co., Inc., sole producer of Neoprene, is permitted to set aside a small quantity for laboratory and experimental purposes. Orders for Great Britain requiring Neoprene are included in the allocations, which are authorized to June 30.

To relieve shortages of aluminum reported to be existing in the aircraft industry, an over-all formula governing its allocation for defense and non-defense purposes has been sent by Priorities Director Stettinius to all producers, fabricators and secondary smelters of aluminum. On the 20th of each month they are required to submit to the priorities division a schedule of their intended deliveries for the succeeding month. Then they are notified of the manner and extent to which they may make their deliveries according to the schedule.

With formal allocations of aluminum in effect, automobile manufacturers using alloy pistons may soon have to replace them with alloy cast iron pistons. However, it is understood they will receive aluminum deliveries dur-

3 FORM-A-GASKETS *by* PERMATEX

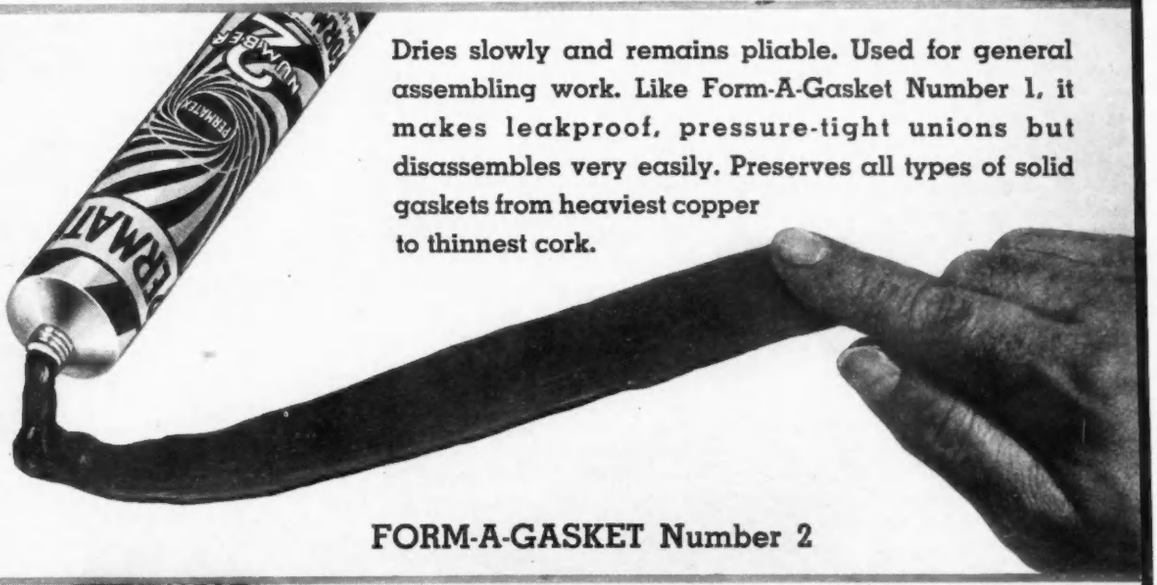
1 Oz. tubes
2 Oz. tubes
8 Oz. tubes



Dries fast, sets hard. Used principally for making permanent assemblies. Makes unions leakproof to gasoline, gasoline vapor, kerosene, hot or cold oil, grease and water. Resists highest pressure and greatest strain.

FORM-A-GASKET Number 1

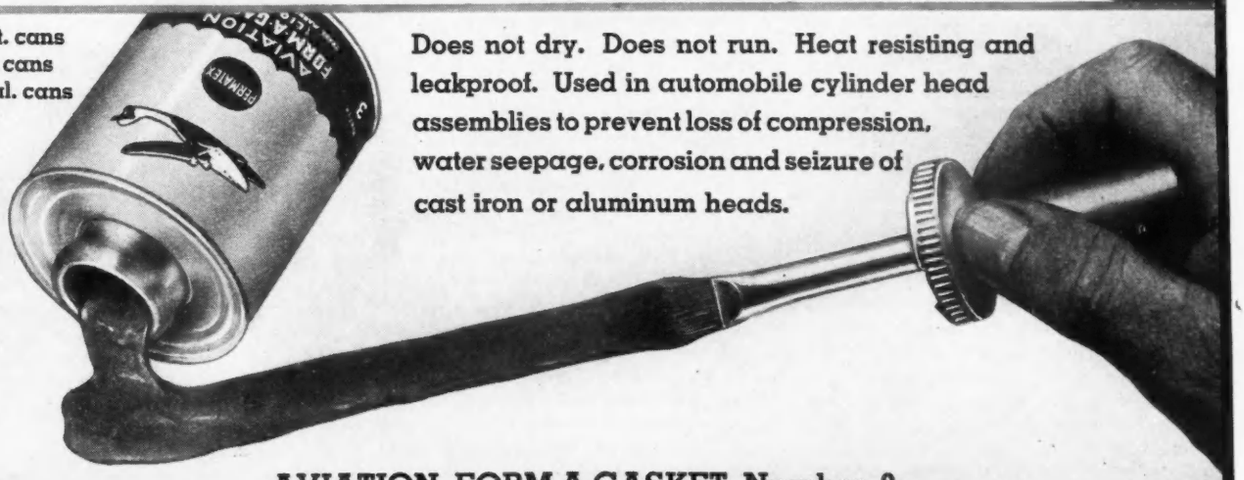
1 Oz. tubes
2 Oz. tubes
8 Oz. tubes



Dries slowly and remains pliable. Used for general assembling work. Like Form-A-Gasket Number 1, it makes leakproof, pressure-tight unions but disassembles very easily. Preserves all types of solid gaskets from heaviest copper to thinnest cork.

FORM-A-GASKET Number 2

¼ Pt. cans
1 Pt. cans
1 Gal. cans



Does not dry. Does not run. Heat resisting and leakproof. Used in automobile cylinder head assemblies to prevent loss of compression, water seepage, corrosion and seizure of cast iron or aluminum heads.

AVIATION FORM-A-GASKET Number 3

PERMATEX COMPANY, INC. Sheepshead Bay, N. Y. U.S.A.

ing April. Aluminum alloy pistons go into about half of the passenger cars produced each year.

Then there is the possibility of using secondary aluminum instead of virgin aluminum until the increasing production relieves the shortage. With adequate supplies of bauxite on hand, aluminum producers are rushing the construction of new plants. A year ago the monthly domestic output of aluminum was 25,000,000 lb., today it exceeds 40,000,000 lb. and by the end of the year it is expected to be about 70,000,000 lb. a month.

Engines in which aluminum alloy pistons are replaced by alloy cast iron pistons, unless the latter are nearly the same weight as the corresponding aluminum units, are likely to require some design changes or governing of the engine speed to offset the effect of the piston weight differential. Pontiac, Chevrolet, Ford and a number of independent truck manufacturers are free of this problem since they already use alloy cast iron or cast steel pistons. Nickel and chromium are important alloy metals in modern cast iron pistons and cylinder blocks, and although specified only in small amounts, both are "critical," which may force metallurgists to adopt some other alloying combinations. Also, it is customary to use a tin coating on pistons to improve surface conditions for "break-in," but this metal is on the priorities critical list and how much might be available for this purpose will depend upon other demands and available supplies.

Producers and consumers of aluminum have been working under a voluntary allocation plan, which was quite effective until the aircraft industry began to speed up production. Some civilian uses of aluminum were eliminated in keeping with the decision to supply only essential demands.

Although an acute situation developed with zinc, it was relieved by a voluntary priorities program through the cooperation of OPM specialists, producers and consumers. As its part, the automobile industry began reducing its consumption of the metal and it is estimated that about 50 per cent less zinc will be used in the 1942 models, mainly by eliminating the die cast type of grille. Zinc scrap and secondary slab zinc have been placed under price control as have iron and steel scrap, second hand machine tools, aluminum scrap and secondary aluminum ingot to prevent hoarding and profiteering.

What about metallic embellishments on automobiles, such as stainless steels, chromium plating and nickel plating for radiator grilles, radio grilles in instrument panels, radiator ornaments, door handles, bumpers, hub caps, interior and exterior moldings and panels? In most cases this type of ornamentation could be eliminated and replaced by plastics or a painted finish for purely decorative purposes. Although the amount of nickel, copper and chromium saved may not be great, it would be a step in defense economy, would not sacrifice any performance or operating durability whatsoever, and the saving could be devoted to maintaining the quality of vital parts in the engine and chassis.

Purchase of practically the entire South American output of copper by the Government forestalled a serious shortage in this country when the current demand was running far ahead of the domestic production. From the automobile manufacturer's standpoint, it is needed for electrical equipment, radiator cores, and also for chromium and nickel plating on steel. But the copper shortage seems to be reappearing. The head of one of the country's largest brass and copper companies has recently made the statement that there are now no domestic offerings of copper at any price or for any delivery.

"It is true," this authority points out, "that there are high cost marginal mines in this country that are not now operating. They cannot operate profitably unless the price of raw copper advances considerably. A higher copper price, however, would result in less than 5 per cent increase in domestic production."

At present, domestic consumption is estimated at about 1,500,000 tons a year, which would absorb the entire domestic production of the United States and South America.

In its survey on the current nickel situation submitted to the materials branch of the OPM production division, the Advisory Committee on Metals and Minerals of the National Academy of Science reports it is informed that current demands for nickel from the trade in the United States greatly exceed the available supply for immediate delivery; the March demand, including the accumulation from previous months, amounts to about 20,000,000 lb. as against about 14,500,000 lb. available. The demand began to increase sharply in the third quarter of 1939 and again during the fourth quarter of 1940 and has been in excess of the spot supply since the beginning of this year.

This increased demand is attributed partly to the mounting volume of U. S. and British Empire defense requirements, the latter being estimated at not more than 30,000,000 lb. Of the estimated total supply of 175,000,000 lb. for the year, about 145,000,000 lb. remains for U. S. defense and industrial requirements. It is pointed out that the 145,000,000 lb. is adequate to provide for industrial requirements at the highest rate ever experienced in a "normal" year, namely 83,000,000 lb. in 1937, and 62,000,000 lb. remains for U. S. defense in addition. However, the committee cautions that the question cannot be finally answered until an adequate estimate can be secured of U. S. defense requirements for the year.

Steel, iron and brass mills and foundries, and electroplaters are the primary consumers of nickel to the extent of 86 per cent. Nickel deliveries to the steel mills, which require about 63 per cent, are employed for a wide variety of constructional and stainless steels which flow into practically all manufacturing industries including the largest one, the automotive industry, the report states.

In regard to nickel electroplating, the committee suggests that other metallic coatings, particularly copper, or paint finishes, be substituted where possible. It reports that steps have been taken by the larger plating establishments and by the automotive industry to reduce substantially their nickel requirements, largely by substituting copper for most of the nickel, yielding a chromium-on-nickel-on-copper electroplate.

In making a substitution of other alloy steels for nickel steels, a choice could be made among chromium-molybdenum steels, chromium-vanadium steels, manganese-molybdenum steels, and chromium, manganese, and chromium-manganese steels. Account should be taken of the availability of these substitutes since they will involve increased requirements for chromium, vanadium and manganese, the committee states.

A common proposal is to substitute the S.A.E. 4100 chromium-molybdenum series for the S.A.E. 3100 nickel-chromium series. This can be done and is being done, according to the report, but it is a form of substitution that must be handled intelligently and with due consideration to the customer's use of the steel. For example, the substitution of case hardening grades of S.A.E. 4100 for S.A.E. 3100 is of much more doubtful efficacy than that of forging grades, because of the different case hardening characteristics of the 4100 series and of the changes in case hardening and heat treatment operations required if the substitution is made, which may necessitate slowing down production.

Another proposal is the replacing of a 5 per cent nickel case hardening steel by a 3½ per cent nickel steel with .25 per cent molybdenum added, which means changing from the S.A.E. 2500 series to the S.A.E. 4800 series. The report also suggests that a 3100 series steel can often be replaced without undue risk with a 3000 series, saving about one-half the nickel content, but does not recommend such substitutions uncritically and over a wide front.

In connection with proposed systems of nickel substitutions, the committee warns that proper attention must be paid to the size or section of the forging or part in question. A particular substitution of one alloy steel for another, which may be feasible for light sections in the small passenger cars, may be entirely inappropriate in larger sections such as are used for heavy-duty trucks, buses and tractors.

Citing as an example of the many ramifications surrounding the selection and use of alloys, reference is made to certain types of roller bearings now manufactured in nickel alloy steels. A change to nickel free steels, apart from

questions concerning performance values, may alter the scaling and distortion properties. Since branches of this industry operate on exceedingly close tolerances in fabrication and use automatic equipment for volume machine production, a minor change in fabricating characteristics of substitute steels could readily upset the existing practices and require retooling of major proportions.

Some substitution of 16-18 per cent chromium stainless steel for 18 per cent chromium-8 per cent nickel stainless steel is being recommended by steel mills, but here again the committee warns that certain limits exist for such substitutions, particularly by the severity of the forming operations required of strip or sheet stock that may make such substitutions not feasible.

In extending the mandatory priorities system to ferro tungsten, tungsten metal powder and tungsten compounds, Government control has been placed on an important metal used in the manufacture of high speed cutting tools. Producers have been urged to encourage their customers to use substitutes for tungsten wherever possible. A large steel producer has lifted royalty restrictions on the manufacture of tools from its low tungsten high speed tool steel, which contains molybdenum and less than one-third the amount of tungsten in ordinary 18-4-1 high speed steels.

Aircraft Propeller Characteristics and Design

(*Continued from page* 420)

2000 hp. at 20,000 ft. altitude should have a propeller of 18 ft. diameter. However, propellers actually in use or planned for military planes of 2000 hp. are considerably smaller. In fighter planes the permissible diameter of propeller is sometimes limited by landing gear dimensions, and again by engine-nacelle location. Such reductions in propeller diameter result in sacrifices in propeller efficiency in flight and in thrust during take off, but design considerations may justify them. The worst cases of propeller-diameter restriction are usually found where a plane is equipped with an engine of greater output than originally contemplated.

The author also considered the use of two-speed gearing, which he said offers the greatest advantages for the fastest planes, but these advantages are important only from the take-off standpoint.

Wide blades are generally required for small, fast planes, while for operation at high speeds, propellers with the tips wide in proportion to the rest of the blade are found to be advantageous. Widening of the blade near the tip is aerodynamically desirable.

The chart herewith shows calculated weights of propellers with from three to six blades, designed to absorb 2000 hp. at 400 m.p.h. at 25,000 ft. altitude. Each point represents a propeller specifically designed for the particular operating conditions. A conclusion drawn from this chart is that the use of propellers of restricted diameter will not result in weight economy unless severe performance reductions are accepted.

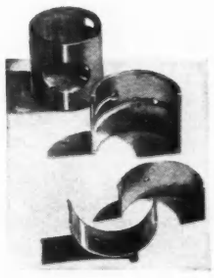
The trend toward propellers with more blades has increased interest in spinners and shank cuffs, because with multiple blades the relative size of the hub increases. Wind tunnel and flight tests, however, have given disappointing results with shank cuffs, though they improve the engine cooling.

Mr. Guerke pointed out that propeller vibration is excited not only by forces originating directly in the engine, but also by operation of the propeller in a region of non-axial airflow and by passage of the blade tips through any disturbed region of air, whether the disturbance is caused by a part of the aircraft structure or by another propeller. While interference with the slipsteam of an adjacently-operating propeller might be considered the strongest exciting factor, it is infrequently encountered. Operation of propellers on concentric shafts, as in dual rotation, will, however, also lead to severe interference conditions.

Babbitt Lined

BEARINGS

for Endurance



Sleeve Bearing Data Sheets

Complete . . . concise . . . factual information concerning the design and application of all types of sleeve bearings . . . of alloys . . . of tolerances and lubrications. Write for a complete set especially designed to fit right into your files. They're free.

● Heat . . . pounding action . . . high speed —are these conditions present in your bearing application? Then consider the use of Babbitt Lined Bearings.

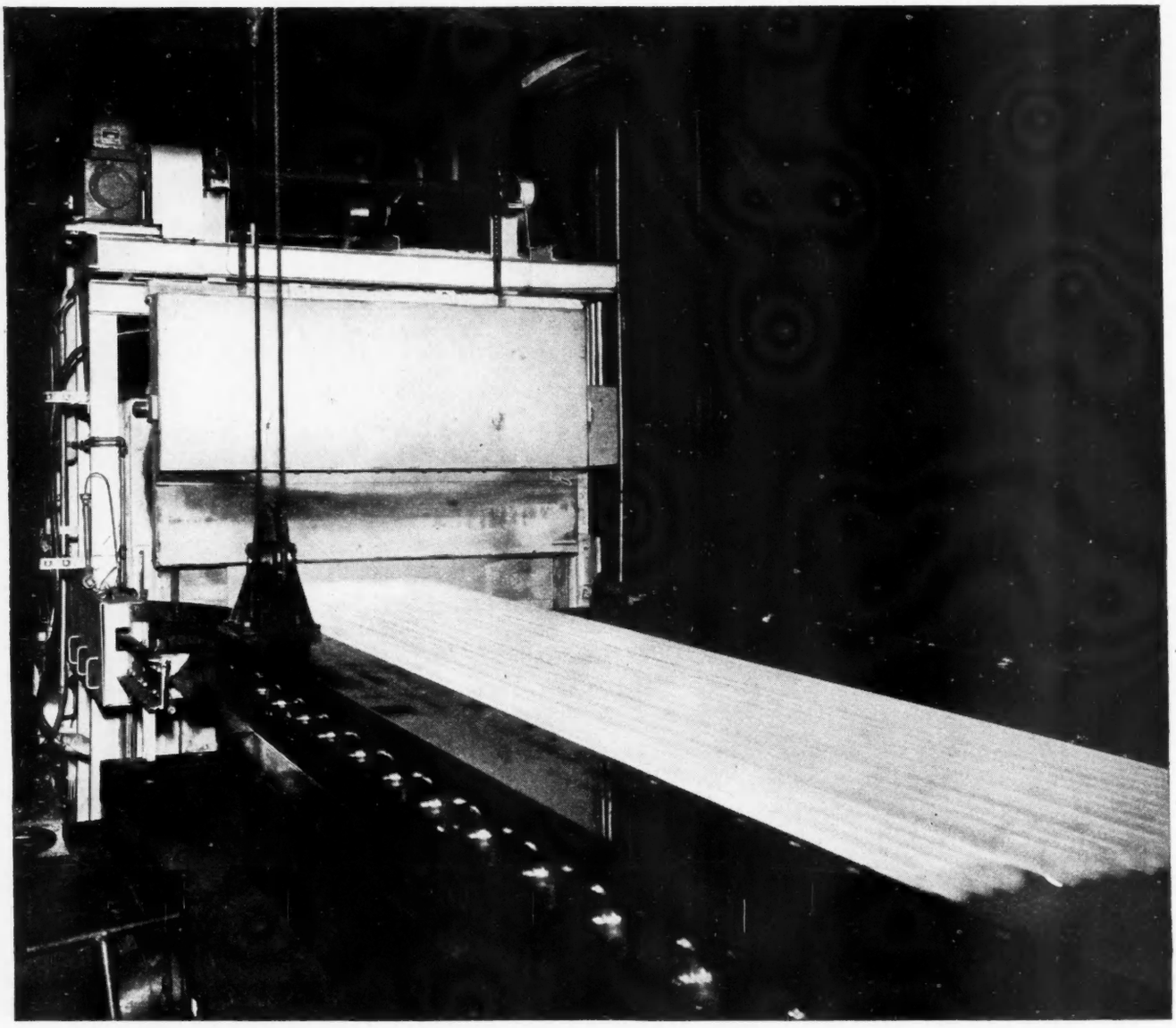
The dual construction of this type of bearing provides characteristics not obtainable in other types. For instance, the babbitt can be alloyed to suit the application—from a high tin to a high lead content. The backing material can be either bronze—in any of various alloys—or steel. Thus a "tailor made" bearing, designed to meet your individual requirements, can easily be produced.

And it's an easy, convenient matter to determine your bearing requirements. Simply call in a Johnson engineer. He will study your application from every angle. All of our recommendations will be based on facts . . . free from prejudice . . . backed by forty years of exclusive bearing experience. Why not write—today.

JOHNSON BRONZE

Sleeve BEARING HEADQUARTERS

625 S. MILL STREET · NEW CASTLE, PA.



Bethlehem increases electric heat-treating capacity

Since speed in production is a growing necessity in current expansion programs, industry's demand for heat-treated alloy steel bars is on the upswing. To meet this demand and anticipate its further development, Bethlehem Steel Company has increased its capacity for electric heat-treating of alloy steel bars.

This Bethlehem development is a distinct gain for consumers of alloy steel. Greater uniformity results from treatment of bars in modern furnaces of the continuous operation type. With Bethlehem as your source of supply you can be assured of receiving the advantage of developments in production methods.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

Fluid-Catalyst Process of Gasoline Production

A PROCESS for the manufacture of gasoline, which is claimed to produce a motor fuel from 10 to 15 octane numbers higher than the product of the thermal-cracking process, has been developed by the Standard Oil Development Co. and the Standard Oil Co., New Jersey. As such high octane numbers are not called for by present-day automobile engines, the gasoline produced by the new process will for the present be used for blending purposes.

Three large commercial plants for the working of the new process are now under construction, the locations being Bayway near Elizabeth, N. J.; Baton Rouge, La., and Baytown, Tex. The Baton Rouge plant is expected to start operations this year, while completion of the other two plants will occur somewhat later. Each of the three plants will have a nominal capacity of 6000 barrels per day.

In addition to yielding a motor fuel of high octane number, the new process is said to have the advantage of greater economy in operation, which is due chiefly to the fact that it is a continuous process. At present catalytic cracking of petroleum is carried out by an intermittent process. Oil vapors are passed through the cracking chamber, which contains the solid catalyst in the form of lumps or pellets. After from 25 to 30 min., the flow of the vapors must be interrupted, because the lumps of catalyst have become coated with carbon formed by the cracking process, which renders them ineffective. It is then necessary to purge the cracking chamber to drive the oil vapors from it and to burn out the accumulated carbon with oxygen. This process of catalyst regeneration takes more time than the cracking proper, and higher operating temperatures are developed than in the cracking process; moreover, considerable expensive apparatus is required. For continuous operation with this process, several cylinders are required, which are shut down successively for regeneration.

With the fluid-catalyst process, cracking operations are carried on continuously in one chamber, regeneration of the fluid catalyst being carried out in a separate zone through which the catalyst flows as a liquid.

The new process is said to be applicable to both gas oil and reduced crude oil, and from gas oil approximately 50 per cent gasoline is obtained. Little or no treating is said to be required by the product. The process operates at atmospheric pressure or little higher.

It is announced that all patent rights relating to the fluid catalytic cracking process have been acquired by the Standard Catalytic Company (formerly the Standard I. G. Company), which is a wholly-owned subsidiary of the Standard Oil Company (New Jersey), and this unit has made working arrangements for licensing under the patents through Universal Products Company and the M. W. Kellogg Company.

Studebaker Skyway Prices

South Bend factory delivered prices, including Federal excise tax, on the new Studebaker Skyway Series have been announced as follows:

COMMANDER SIX	
Cruising Sedan	$1,075
Land Cruiser	1,105
PRESIDENT EIGHT	
Cruising Sedan	1,205
Land Cruiser	1,235

Prices include as standard equipment rear wheel shields, whitewall tires, fender parking lights, concealed running boards, deluxe phantom steering wheel, deluxe front bumper with winguards, chrome wheel discs and trim ring and automatic hill-holder. In addition to solid black, the Skyway Series is offered in six exterior two-tone color binations.

RIVETING THROATS
from 6 to 45 inches
in the New Complete Line of
CHICAGO RIVET'S
Automatic Riveting Machines
Designed Especially for
AIRCRAFT RIVETS
PROMPT DELIVERY
A SPECIAL BROCHURE
illustrating and describing 4 models of Chicago Rivet's new aircraft automatic rivet setters sent upon request to any interested executive.
Chicago
TUBULAR AND SPLIT RIVETS • AIRCRAFT RIVETS
Chicago RIVET & MACHINE CO.
1862 South 54th Ave. (Cicero P. O.) Chicago, Illinois
AUTOMATIC AND MANUAL RIVET SETTERS FOR 1 TO 4 RIVETS AT A STROKE

AUTOMOTIVE MATERIALS

(*Continued from page 435*)

Koroplate Paint Is Chemical Resistant

KOROPLATE is the name of a new paint that is being manufactured by the B. F. Goodrich Co., Akron, for protecting metal surfaces against chemical reactions, including extremely corrosive conditions. Base of the new paint is Koroseal, a synthetic material created in the Goodrich laboratories from polyvinyl chloride, which is derived by a series of chemical reactions from coke, limestone and salt.

The new paint is liquid at room temperatures and requires no heating before application. At ordinary temperatures it can be either brushed or sprayed. It is made only in semi-glossy black.

When thoroughly dry, Koroplate is said to be extremely resistant to the action of vapors from acids, alkalies and salts at room temperatures or slightly above. It resists acids except concentrated formic and acetic, and the Goodrich engineers further state that it is not affected by brass, chrome, nickel, cadmium, zinc, copper, silver or tin plating solutions. Such solutions are not contaminated by or fouled by the thoroughly dried paint, although it is not recommended for constant immersion in such liquids. Among its successful uses are applications on sour crude storage lines, underground pipes, and fume ducts in plating rooms.

Directional Control of Fluorescent Light

PLASTACELE, a cellulose acetate plastic marketed by the E. I. du Pont de Nemours & Co. in sheets, rods, tubes and molding powder, is now made in a new form for enclosures to provide a convenient method for the directional control of fluorescent light. Incorporated in the sheeting are alternate transparent and translucent sections that permit diffusion and concentration of the light by placing the sheet at the proper angle.

Glass Cloth Electrical Insulation

GLASS CLOTH, impregnated and coated with heat resisting varnishes developed especially for this purpose, is now available for use as insulation by manufacturers of electric motors, generators and similar equipment. This new insulation material, known as Irvington Varnished Fiberglas, is furnished in full-width rolls and tape of various widths and thicknesses by the Irvington Varnish & Insulator Company, Irvington, N. J.

The material consists of a woven glass cloth base (Owens-Corning Fiberglas), impregnated and coated with a special varnish which greatly increases its resistance to abrasion and impact, and its overall mechanical strength. The resulting material is said to have higher insulating resistance and greater ability to withstand heat than other flexible insulations.

Cloth Diaphragm For Automobile Fuel Pumps

BLOSSOM MFG. CO., New York, has added to its line of products a special cloth for use as a diaphragm in automobile fuel pumps. This new fabric is said to be exceptionally strong, durable, flexible and gasoline resistant.

Plastic Moldings and Trim

AS A substitute for aluminum products, for which it may prove difficult to obtain materials because of defense requirements, the R. D. Werner Co., Inc., New York, finisher of extruded and metal holdings, has announced a new line of plastic products under the trade names "Plastikmould" and "Plastiktrim." These new plastic products are being manufactured in a wide range of colors, in similar shapes and sizes as now supplied in aluminum, also in the forms of rods, tubes, etc., both flexible and rigid.

THAT'S THE PRODUCTION THIS MANUFACTURER IS GETTING with Easy-Flo brazing alloy, in joining 5/16" steel studs to .020" stainless steel fender trim for a popular car and the alloy and flux cost is only ½ cent per joint.

In service these joints are under continual strain from the nut holding them to the fenders. They are subject to considerable vibration and to the severe "weathering" fenders must take. The manufacturer has **"never heard of a joint coming apart."**

Before using Easy-Flo, it was difficult to keep the thin trim from buckling when heated. The low working temperature of Easy-Flo has solved this problem.

The fast-acting, low-temperature Easy-Flo is daily giving high speed production with reliability and economy to manufacturers all over the country. It is equally effective for joining ferrous, non-ferrous and dissimilar metals. Try it on one job in your plant. We'll be glad to assist. For Easy-Flo details write for Bulletin AI-10.

The simple procedure illustrated speeds up production. Girls on one side of a row of fixtures Handy Flux the studs and place them on the trim. Plungers hold the 8 studs on each trim in exact position. Moving along the opposite side of the row, the brazer applies the heat with a torch and joins studs to trim forever with Easy-Flo.

HANDY & HARMAN 82 FULTON ST., NEW YORK

Agents in Principal Cities. In Canada: HANDY & HARMAN of Canada, Ltd., Toronto

Spring Efficiency And a Good Ride

(*Continued from page* 433)

to be equal to one-half the square of the stress divided by the modulus of elasticity in tension.

$$K = \frac{S^2}{2E}$$

Where K = unit elastic resilience (energy content per unit volume).

Where S = fibre stress.

Where E = modulus of elasticity in tension.

It may also be shown that in leaf springs, the leaves are used in bending, which produces stresses in tension and compression that are not uniform throughout the leaf section and, therefore, the energy stored per cubic inch is one-sixth the square of the stress divided by the modulus of elasticity in tension:

$$K_L = \frac{S^2_t}{6E}$$

In the coil spring the wire is in torsion, which produces shearing stresses that are not uniform throughout the wire section and, therefore, the energy stored per cubic inch is one-quarter the square of the stress divided by the modulus of elasticity in shear:

$$K_c = \frac{S^2_s}{4G}$$

A comparison of these last two equations indicates that the coil spring uses its material 50 per cent more efficiently. Further, since the modulus of elasticity in tension is 2.57 times that in shear, and the elastic limit in shear is only 66 per cent that in tension, a direct comparison of K between coil and leaf spring is:

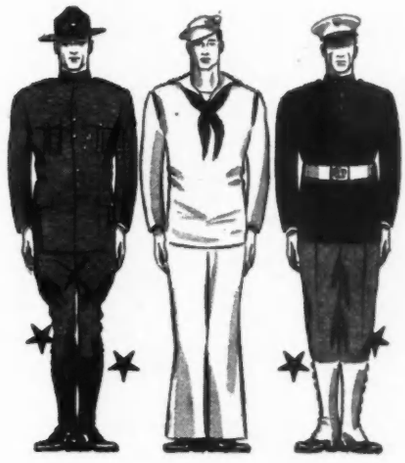
$$\frac{K_c}{K_L} = \frac{6}{4} \times \left(\frac{66}{100}\right)^2 \times \frac{29{,}000{,}000}{11{,}300{,}000} = 1.68$$

Since the coil spring, theoretically, can do 68 per cent more work than a leaf spring of the same weight, it can do the same amount of work with only 60 per cent as much material.

Fostoria Acquires License

Exclusive manufacturing and sales rights to the EvenRay infra-red process equipment has been acquired from Dewey Thibault & Co. of Boston by the Fostoria Pressed Steel Corp., Fostoria, Ohio. Equipment manufactured under this license will be branded Fostoria EvenRay ParaSphere, the name "ParaSphere" being the Fostoria basic trade mark for its infra-red process line. The new design is claimed to give even distribution of radiant energy over the areas radiated, without high and low spots, and to accomplish given results in drying, baking, dehydrating and preheating with infra-red bulbs of lower wattage.

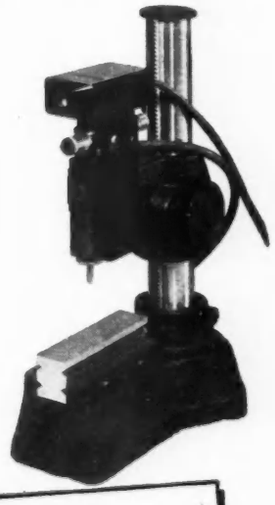
Prepare For INSPECTION



The Sheffield Electrigage has eliminated the bottleneck of slow, tedious dimension checking in many inspection departments because it flashes its answer instantly—just as fast as the work pieces are presented. If the signal light flashes amber the part being gaged is within specified tolerances. Green shows oversize, red undersize.

The accuracy of this gage is .000010" at any tolerance. It can be set for tolerances from .012" to .000050".

The Electrigage is flexible, consisting of a gaging head, light unit and base. The three elements may be used in one assembly for inspection department work or for checking purchased parts on arrival. The gaging head may be mounted on a machine to check parts in the process of manufacture while still on the machine. In such use the light unit may be assembled with the gaging head or with other light units at some location which would permit the control of several machines by one man.



Write for information about the wide use of the Sheffield Electrigage.

SHEFFIELD

GAGE CORPORATION • DAYTON, OHIO, U.S.A.

MASTER GAGEMAKERS

New Features in the Packard Clipper

(*Continued from page* 429)

plant, thereby reducing the friction which usually results. The arrangement consists of a bell-crank mounting attached directly to the block for transmitting the shift and cross-over movement to the transmission. The vertical shaft for the mounting is pivoted at its lower end, so that it is free to move only in the transverse plane. The upper end of the shaft is connected to the levers from the steering column. Although this produces a fixed alignment of the linkage to the transmission, it makes possible neutralization of the mis-alignment between the steering column and powerplant due to lateral engine movement.

The chassis frame is of the double-drop type, with tapered side rails. It is exceptionally wide, to provide support for the wide body, and is rendered unusually rigid by the introduction of an X-member 9½ in. in depth. Side rails are stiffened by the use of box sections extending forward from the X-member to the front, and at the rear by extensions of the X-member over the kick-up, terminating at the rear cross member. A solid foundation for both the front suspension and engine mounting is afforded by an exceptionally wide and deep box-section front cross member.

Front suspension has the characteristics of the Packard Safe-T-Flex suspension but embodies a different mechanical design. On the Clipper, it is essentially of the wish-bone type with low frequency coil springs, continuing the use of the double-acting, arm-type shock absorbers. However, the radius arms characteristic of the standard Packard suspension system are not used. It is claimed that the new arrangement makes it feasible to divide braking torque between the upper and lower levers of the wheel suspension, thus making radius arms unnecessary.

Forty-six anti-friction bearings are used in various parts of the mechanism. An interesting feature of the front suspension is the adoption of needle bearings for the top end of the steering knuckle, plain bearings at the lower end and in addition, a ball-type of thrust bearing. Sealed threaded bushings replace the rubber bushings in the front suspension.

The rear springs, while of the same general design as the Safe-T-Flex system and incorporating the friction control buttons, are so mounted in the chassis as to carry the front ends closer to the center of the chassis, thus producing a tapered platform, said to promote lateral stability. Direct-acting shock absorbers are fitted at the rear, but are mounted back of the rear axle, with the top ends inclined toward the center. In addition, a new type of direct-acting shock absorber has been adopted for the fifth shock. It is an integral part of the rear stabilizer which extends from the frame bracket on one side to the axle pad on the opposite side. Rear shackles are rubber-bushed.

The steering gear, of the worm and double-tooth roller type, with a reduction of 20.19 to 1, incorporates a straddle-mounted shaft. The steering linkage, completely redesigned, features the familiar parallel-linkage layout. The pitman arm now connects to a parallel idler arm on the other side of the frame and transfers movement to the wheels through short tie-rods on each side.

The rear axle is the same as that on the One-twenty, except for detail changes in the housing to accommodate the new suspension system. It is of semi-floating type, with hypoid gears, with a standard gear ratio of 4.09.

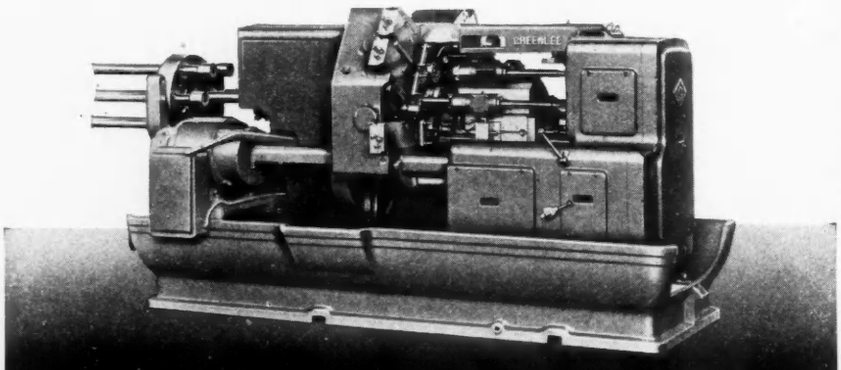
Brakes are of the hydraulic, two-shoe type with 12 in. Centrifuse drums. Tires are 15 x 7.00.

WHEN IT'S ALL OVER

When it's all over . . . when the emergency has passed . . . when you're back at normal peace-time production . . . will you be able to use profitably then, the machines you buy today? You want machines with speed today, but these same machines must also be able to take care of tomorrow's normal production requirements.

Today the speed, accuracy, and economy of Greenlee Six-Spindle Automatic Screw Machines are enabling hundreds of manufacturers to turn out vital defense orders with all possible speed. And when the emergency is over, these Greenlee Machines . . . designed right and built right to stand the wear and tear of today's production . . . will be turning out ordinary peace-time parts just as fast and just as accurately as they now produce defense work. Before buying your next machine, find out if the Greenlee isn't the most profitable machine you could buy for both today's work and normal production later.

GREENLEE BROS. & CO. • ROCKFORD, ILL.



GREENLEE

Automatic Screw Machines